

# PROCEEDINGS

## MICROSCOPY & MICROANALYSIS 2014

### Part 1: Biological Sciences Symposia

**Microscopy Society of America**

72nd Annual Meeting

**Microanalysis Society**

48th Annual Meeting

**International Metallographic Society**

47th Annual Meeting

**Microscopical Society of Canada / Société  
de Microscopie du Canada**

41st Annual Meeting

**International Union of Microbeam  
Analysis Societies**

6th Society Meeting

**Hartford, Connecticut, USA**

*August 3-7, 2014*

*Edited by*

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PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE  
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS

The Edinburgh Building, Cambridge CB2 2RU, UK  
32 Avenue of the Americas, New York, NY 10013-2473, USA  
477 Williamstown Road, Port Melbourne, VIC 3207, Australia  
Ruiz de Alarcón 13, 28014 Madrid, Spain  
Dock House, The Waterfront, Cape Town 8001, South Africa

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First published 2014

Printed in the United States of America

This publication constitutes Supplement 3 to Volume 20, 2014 of *Microscopy and Microanalysis*.

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# Microscopy AND Microanalysis

An International Journal for the Biological and Physical Sciences

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THE OFFICIAL JOURNAL OF

MICROSCOPY SOCIETY OF AMERICA  
MICROANALYSIS SOCIETY  
MICROSCOPICAL SOCIETY OF CANADA /  
SOCIÉTÉ DE MICROSCOPIE DU CANADA  
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EUROPEAN MICROBEAM ANALYSIS SOCIETY  
AUSTRALIAN MICROSCOPY AND MICROANALYSIS SOCIETY  
PORTUGUESE SOCIETY FOR MICROSCOPY

PUBLISHED IN AFFILIATION WITH

ROYAL MICROSCOPICAL SOCIETY  
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### **Office of Publication**

Cambridge University Press, 32 Avenue of the Americas, New York, NY 10013-2473, USA. Tel: (212) 337-5000; Fax: (212) 337-5959.

# Microscopy & Microanalysis

The Official M&M 2014 Proceedings  
Hartford, Connecticut, USA • August 3-7, 2014



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- 410 *Atomic and Electronic Structure of  $\gamma$ Fe<sub>2</sub>O<sub>3</sub>/Cu<sub>2</sub>O Heterostructured Nanocrystals*; Q. Qiao, M. A. Roldan, M. Varela, S. T. Pantelides; Oak Ridge National Laboratory; Q. Qiao, Y. Zhang, S. T. Pantelides; Vanderbilt University, Nashville; P. Mirtchev, G. Ozin; University of Toronto, Toronto, Canada; M. A. Roldan, M. Varela; Universidad Complutense de Madrid, Spain; D. D. Perovic; University of Toronto, Toronto, Canada; S. J. Pennycook; University of Tennessee, Knoxville
- 412 *Structural Changes of Ta<sub>2</sub>O<sub>5</sub> Photocatalyst under Reaction Conditions*; Q. Liu, P. A. Crozier; Arizona State University
- 414 *Using (S)TEM Techniques to Study Energy related Materials at the Nanoscale*; J. C. Walmsley, P. E. Vullum; SINTEF Materials and Chemistry, Norway; J. C. Walmsley, P. E. Vullum, R. Holmestad; Norwegian University of Science and technology, Norway
- 416 *Morphology of Ruthenium Particles for Methanation Under Reactive Conditions*; T. W. Hansen, D. Deiana; Technical University of Denmark, Denmark; F. Masini, J. H. Nielsen, Ib. Chorkendorff; Technical University of Denmark, Denmark
- 418 *Fine Tuning Highly Active Pt<sub>3</sub>Ni<sub>7</sub> Nanostructured Thin Films for Fuel Cell Cathodes*; D. A. Cullen; Materials Science & Technology Division; K. L. More; Center for Nanophase Materials Sciences; M. Lopez-Haro, P. Bayle-Guillemaud; Minatec, France; L. Guetaz; CEA, LITEN, France; M. K. Debe, D. F. van der Vliet, A. J. Steinbach; 3M Co.
- 420 *Cerium Reduction at the Interface Between Ceria and Ytria-Stabilised Zirconia and Implications for Interfacial Oxygen Non-stoichiometry*; K. Song, V. Srot, P. A. van Aken; Max Planck Institute for Intelligent Systems, Germany; K. Song, K. Du; Shenyang National Laboratory for Materials Science, China; H. Schmid; INM-Leibniz Institute for New Materials, Germany; E. Gilardi, G. Gregori, J. Maier; Max Planck Institute for Solid State Research, Germany
- 422 *Studying Dynamics of Oxygen Vacancy Ordering in Epitaxial LaCoO<sub>3</sub> / SrTiO<sub>3</sub> Superlattice with Real-Time Observation*; J. H. Jang, Y.-M. Kim, Q. He, L. Qiao, M. D. Biegalski, A. R. Lupini, S. J. Pennycook, S. V. Kalinin, A. Y. Borisevich; Oak Ridge National Laboratory; Y.-M. Kim; Korea Basic Science Institute, Korea; R. Mishra, S. T. Pantelides; Vanderbilt University

- 424 *In-situ Electrochemical Liquid Cell TEM Visualization of Electrode-Electrolyte Interfaces*; H. Zheng; Lawrence Berkeley National Laboratory, University of California
- 426 *Multimode STEM Imaging and Tomography of Radial Heterostructure Nanowire Li-Ion Mini-Batteries*; V. P. Oleshko, A. V. Davydov, S. Krylyuk; Material Measurement Laboratory; T. Lam, D. Ruzmetov, P. Haney, H. J. Lezec, A. A. Talin; National Institute of Standards and Technology; D. Ruzmetov, S. Krylyuk; Institute for Research in Electronics and Applied Physics; V. P. Oleshko, J. Cumings; University of Maryland; A. A. Talin; Sandia National Laboratories
- 428 *Direct Atomic-Scale Imaging of Multistep Phase Transition During the Lithiation of Nanowires by In-Situ (S)TEM*; A. Nie, R. S.-Yassar; Michigan Technological University; S. Vaddiraju; Texas A&M University; A. Nie, R. F. Klie, R. S.-Yassar; University of Illinois at Chicago; R. S.-Yassar; University of Illinois at Chicago
- 430 *Probing the Local Chemical and Structural Ordering of Iron Oxyfluoride*; D. Su, K. He; Brookhaven National Laboratory; S.-W. Kim, J. Graetz, F. Wang; Brookhaven National Laboratory; N. Pereira, G. G. Amatucci; Rutgers University
- 432 *Spatially Resolved Characterization of Phases in LiFePO<sub>4</sub> Battery Cathodes Using Low Loss Electron Energy-loss Spectroscopy*; S. A. Channagiri, G. B. Viswanathan, R. Nichol, D. W. McComb; The Ohio State University; S. C. Nagpure; The Ohio State University
- 434 *Revealing the Origin of “Phonon Glass–Electron Crystal” Behavior in Thermoelectric Layered Cobaltate by Accurate Displacement Measurement*; L. Wu, Q. Meng, D. Su, Q. Li, Y. Zhu; Brookhaven National Laboratory; Ch. Jooss; University of Goettingen, Germany; J.-C. Zheng; Xiamen University, China; H. Inada; Hitachi High Technologies Corp, Japan
- 436 *Surface Reduction in Monoclinic BiVO<sub>4</sub> for Photocatalytic Applications*; M. D. Rossell, R. Erni; Swiss Federal Laboratories for Materials Science and Technology, Switzerland; A. Borgschulte; Laboratory for Hydrogen & Energy, Switzerland
- 438 *Nanostructure-Assisted Phonon Scattering in Lead-Free Thermoelectric Materials: A TEM Investigation of the SnTe System*; F. Shi, S.-H. Lo, V. Dravid; Northwestern University; G. Tan, I.-D. Zhao, M. G. Kanatzidis; Northwestern University; M. G. Kanatzidis; Argonne National Laboratory
- 440 *Observing the Interplay Between Composition and Phonon Transport in Bi<sub>2</sub>Te<sub>3-x</sub>Se<sub>x</sub> Alloys using ADF STEM*; J. H. Dycus, A. Oni, X. Sang, T. Chan, C. Koch, J. M. LeBeau; North Carolina State University
- 442 *Capturing the Structure of Mesoporous Silica Nanoparticles in Solution with Cryo-TEM*; K. A. Spoth, L. F. Kourkoutis, Y. Sun, U. Wiesner, L. F. Kourkoutis; Cornell University
- 444 *A 3-D Phase Evolution Panorama Uncovered Using a Grid-in-a-Coin Cell Method for Conversion Reaction Electrodes in Lithium-ion Batteries*; H. L. Xin; Brookhaven National Laboratory; F. Lin; Lawrence Berkeley National Laboratory
- 446 *Characterizing Sulfur in TEM and STEM, with Applications to Lithium Sulfur Batteries*; B. D. A. Levin, M. J. Zachman, L. F. Kourkoutis, David A. Muller, J. G. Werner, U. Wiesner; Cornell University

- 448 *Understanding the Surface Structure of  $\text{LiNi}_{0.45}\text{Mn}_{1.55}\text{O}_4$  Spinel Cathodes with Aberration-Corrected HAADF STEM*; C. Amos, J. Song, J. Goodenough, P.J. Ferreira; University of Texas, Austin
- 450 *Tracking Displacement Reactions in  $\text{Cu}_x\text{V}_2\text{O}_5$  Cathodes by In-Situ TEM*; P. Gao, X. wang, L. Wang, F. Wang; Brookhaven National Laboratory
- 452 *Probing Electrochemical Cycling Stability of Li-ion Cathode Materials at Atomic-scale*; M. Chi; Oak Ridge National Laboratory; B. Xu, C. R. Fell, S. Meng; University of California, San Diego; J. Yang; University of Washington
- 454 *In-situ TEM Observation of Electrochemical Cycling of a Si/TiO<sub>2</sub> Composite NW*; S. J Kim, X. Pan; University of Michigan; A. Kargar, D. Wang; University of California, San Diego
- 456 *Analyses of Interfaces in Wafer-Bonded Tandem Solar Cells by Aberration-Corrected STEM and EELS*; D. Häussler, W. Jäger; Christian Albrechts University Kiel, Germany; L. Houben, R. E. Dunin-Borkowski; Research Centre Juelich GmbH, Germany; St. Essig, F. Dimroth; Fraunhofer Institute for Solar Energy Systems ISE, Heidenhofstraße 2, Germany
- 458 *Electron Microscopy Study of the Deactivation of Nickel Based Catalysts for Bio Oil Hydrodeoxygenation.*; D Gardini, C. D. Damsgaard, P. M. Mortensen, P. A. Jensen, A. D. Jensen, C. D. Damsgaard; Technical University of Denmark, Denmark; J.-D. Grunwaldt; Institute for Chemical Technology and Polymer Chemistry, Germany
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- 464 *Probing Structure-Property Relationship of Active Metal Nanoparticles on Mesoporous Silica Sorbent.*; P. Kumar, J. S. Jeong, B. Elyassi, N. Rajabbeigi, M. Tsapatsis, K. A. Mkhoyan; University of Minnesota
- 466 *Effect of Yttrium (Y) and Zirconium (Zr) Doping on the Thermodynamical Stability of the Cubic  $\text{Ba}_{0.5}\text{Sr}_{0.5}\text{Co}_{0.8}\text{Fe}_{0.2}\text{O}_{3-\delta}$  Phase*; M. Meffert, P. Müller, H. Störmer, D. Gerthsen, L.-S. Unger, C. Niedrig, S. F. Wagner, E. Ivers-Tiffée; Karlsruhe Institute of Technology; S. Saher, H. Bouwmeester; University of Twente, The Netherland
- 468 *Observation of Pt-Atom Complexes in  $\text{CaTi}_{1-x}\text{Pt}_x\text{O}_{3-\delta}$* ; S. Y. Zhang, X. F. Du, G. W. Graham, X. Q. Pan; University of Michigan; M. B. Katz; Naval Research Laboratory
- 470 *HAADF STEM of Phase Separated Anion Exchange Membranes Prepared by Ultracryomicrotomy*; A. C. Jackson, F. L. Beyer; U.S. Army Research Laboratory; Y. Li, D. M. Knauss; Colorado School of Mines; J. R. Nyzaka, Y. A. Elabd; Drexel University; S. D. Walck; Bowhead Technical Services
- 472 *Effects of Sample Preparation Technique on Quantitative Analysis of Automotive Fuel Cell Catalyst Layers*; L. G. de A. Melo, V. Lee, G. A. Botton, A. P. Hitchcock; McMaster University; D. Susac, V. Berejnov, J. Stumper; AFCC Automotive Fuel Cell Cooperation Corp



- 474 *Local Composition of Alloy Catalysts for Oxygen Reduction by STEM-EDS*; D. Deiana, A. Verdaguer-Casadeval, P. Hernandez Fernandez, F. Masini, C. Streb, D. N. McCarthy, A. Nierhoff, J. H. Nielsen, I. E. L. Stephens, I. Chorkendorff, J. B. Wagner, T. W. Hansen; Technical University of Denmark, Denmark
- 476 *In-situ TEM and Atomic-Resolution STEM Study of Highly Active Partially Ordered Cu<sub>3</sub>Pt Nanoparticles Used as PEM-Fuel Cells Catalyst*; G. Dražić, M. Bele, A. Pavličič, P. Jovanovič, M. Zorko, N. Hojnik, B. Jozinovič, M. Gaberšček; National Institute of Chemistry, Slovenia
- 478 *STEM-EDS Characterization of Platinum-Modified Nickel Nanoparticles*; D. H. Anjum; King Abdullah University of Science & Technology (KAUST), Saudi Arabia; L. Li; King Abdullah University of Science & Technology, KSA
- 480 *Aberration-Corrected STEM Study on Pt<sub>0.8</sub>Ni De-alloyed Nanocatalysts for Proton Exchange Membrane Fuel Cells*; S. Rasouli, P. Ferreira; University of Texas at Austin; J. Sharman, A. Martinez, D. Fongalland, G. Hards; Johnson Matthey Technology Centre; T. Yamamoto, K. Higashida; Kyushu University, Japan; D. Myers; Argonne National Laboratories
- 482 *Degradation Mechanisms of Platinum Nanoparticle Catalysts in Proton Exchange Membrane Fuel Cells: The Role of Particle Size*; K. Yu, D. J. Groom, P. J. Ferreira; The University of Texas at Austin; Z. Yang, M. Gummalla; United Technology Research Center; S. C. Ball; Johnson Matthey Technology Center; X. Wang, D. Myers; Argonne National Laboratory
- 484 *Uncovering Structure-Properties Relations in Fuel Cells and Catalysts with Quantitative Aberration-Corrected STEM and EELS*; J. H. Jang, Q. He, D. N. Leonard, A. Y. Borisevich, A. Kumar, S. Kalinin; Oak Ridge National Laboratory; Y.-M. Kim; Korea Basic Science Institute, Korea
- 486 *An Advanced Quantitative Analysis of Li in LIB with AES Preparation For a Clean Cross Section with the Cross Section Polisher*; A. Tanaka, K. Tsutsumi, H. Onodera, T. Tazawa; JEOL Ltd., Japan
- 488 *Quantitative oxidation state analysis of transition metals in a lithium-ion battery with high energy resolution AES*; A. Tanaka, K. Tsutsumi, H. Onodera, T. Tazawa; JEOL Ltd., Japan
- 490 *Discovering a Novel Sodiation in FeF<sub>2</sub> Electrodes for Sodium-Ion Batteries*; K. He, D. Su; Brookhaven National Laboratory; P. Gao, F. Wang; Brookhaven National Laboratory; N. Pereira, G. G. Amatucci; Rutgers University; Y. Zhu; Brookhaven National Laboratory
- 492 *Transmission Electron Forward Scattered Diffraction and Low Voltage SEM/STEM Characterization of Binder-Free TiO<sub>2</sub> Electrodes*; M. Sussman, N. Brodusch, R. Gauvin, G. P. Demopoulos; McGill University, Canada
- 494 *Imaging and Spectroscopy of Pristine and Cycled Li<sub>2</sub>MnO<sub>3</sub>*; P. J. Phillips, R. F. Klie; University of Illinois at Chicago; H. Iddir; Argonne National Laboratory; R. Benedek, D. P. Abraham; Argonne National Laboratory
- 496 *In-situ TEM Study on Electrochemical Behavior of  $\alpha$ -MnO<sub>2</sub> Nanowire*; Y. Yuan, A. Nie, R. Shahbazian-Yassar; Michigan Technological University; S. Santhanagopalan, D. D. Meng; University of Texas at Arlington

- 498 *Characterization of a Layered Lithium Manganese-rich Oxide Cathode Material via Scanning Transmission Electron Microscopy*; A. C. Johnston-Peck, L. A. Bendersky, A. A. Herzing; National Institute of Standards and Technology
- 500 *Microstructural and Microchemical Analyses of Extracted Second-Phase Precipitates in Alpha-Annealed and Beta-Quenched Zircaloy-4*; K. R. Anderson, R. Bajaj; Bechtel Marine Propulsion Corp. – Bettis Laboratory
- 502 *Probing the Reaction Mechanism for Highly Reactive Nanothermite Formulations*; RJ Jacob, W-A Chiou, MR Zachariah; University of Maryland, College Park
- 504 *Tomography and Spectroscopy of Structure and Degradation in Carbon Electrode Materials for Energy Conversion and Storage*; E Padgett, ME Holtz, DA Muller; Cornell University
- 506 *Understanding the Role of Potassium Doping in PbTe-PbS Thermoelectrics*; HJ Wu, FS Zheng, D Wu, X Tong, JQ He; South University of Science and Technology of China, China; L-D Zhao; Northwestern University, Evanston; YL Pei; Beihang University, China
- 508 *ZnO Nanowire-supported Ag Catalyst for Methanol Steam Reforming*; JX Liu, JY Liu, J Xu; Arizona State University, Tempe; YD Huang, JX Liu; Harbin Institute of Technology, China
- 510 *Characterization of Aluminum and Nickel Thermochemical Diffusion for Synthesis of Alkaline Water Electrolysis Electrodes*; H Alimadadi, C Kjartansdóttir, T Kasama, P Møllerl; Technical University of Denmark, Denmark
- 512 *In-Situ TEM Electrochemical Processes in Conversion-Based Li-Ion Battery Electrodes*; K Karki, F Wang; Brookhaven National Laboratory; GG Amatuucci; Rutgers University; MS Whittingham; University of New York at Binghamton

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- 514 *Defect Physics in Photovoltaic Materials Revealed by Combined High-Resolution Microscopy and Density-Functional Theory Calculation*; Y Yan, Y Yu, W-J Yin, Z Wang, NR Paudel; The University of Toledo; C Li, J Poplawosky, TJ Pennycook; Oak Ridge National Laboratory; WK Metzger, I Repins, MM Al-Jassim; National Renewable Energy Laboratory, Golden; SJ Pennycook; University of Tennessee, Knoxville
- 516 *Creating Single Boundary Between Two CdTe (111) Wafers with Controlled Orientation by Wafer Bonding*; C Sun, N Lu, G Lian, J Wang, X Peng, MJ Kim; The University of Texas at Dallas, Richardson; RF Klie; University of Illinois at Chicago
- 518 *Understanding Individual Defects in CdTe Solar Cells: From Atomic Structure to Electrical Activity*; C Li, J Poplawsky, AR Lupini, MP Oxley; Oak Ridge National Laboratory; C Li; Vanderbilt University, Nashville; Y Wu, N Paudel, Y Yan; The University of Toledo; J Poplawsky, SJ Pennycook; University of Tennessee, Knoxville; TJ Pennycook; University of Oxford, UK; TJ Pennycook; SuperSTEM Laboratory, UK; SJ Haigh; University of Manchester, UK

- 520 *High Resolution EELS Study of  $Ge_{1-y}Sn_y$  and  $Ge_{1-x}Si_xSn_y$  Alloys*; L Jiang, J Menéndez, T Aoki, J Kouvetakis; Arizona State University, Tempe
- 522 *Characterization of Poly-Crystalline CdTe Solar Cells Using Aberration-Corrected Transmission Electron Microscope*; T Paulauskas, E Colegrove, C Buurma, RF Klie; University of Illinois at Chicago, Chicago; M Kim; University of Texas at Dallas
- 524 *Atomic Scale Studies of Structure and Bonding in AlPSi3 Alloys Grown Lattice-Matched on Si(001)*; T Aoki, L Jiang, AVG Chizmeshya, J Menéndez, J Kouvetakis, DJ Smith; Arizona State University, Tempe
- 526 *Compositional and Structural Analysis of Al-Doped ZnO Multilayers by LEAP*; AD Giddings, TJ Prosa, DJ Larson; CAMECA Instruments Inc, Madison; Y Wu, MA Verheijen, F Roozeboom, WMM Kessels; Eindhoven University of Technology, The Netherlands
- 528 *Density Functional Theory Modeling of Twin Boundaries in CdTe as Informed by STEM Observations*; C Buurma, T Paulauskas, Z Guo, R Klie; University of Illinois at Chicago, Chicago; MKY Chan; Argonne National Laboratory
- 530 *Interfaces and Extended Structural Defects in Chalcopyrite Thin-Film Solar Cells Studied by Transmission Electron Microscopy*; SS Schmidt, J Dietrich, S Merdes, D Abou-Ras; Helmholtz-Zentrum Berlin für Materialien und Energie, Germany; CT Koch; Ulm University, Germany; B Schaffer, M Schaffer; STFC Daresbury Laboratories, United Kingdom; M Klingsporn; Leibniz-Institut für innovative Mikroelektronik, Germany
- 532 *Photoluminescence Imaging of Semiconductors*; K Alberi, B Fluegel, A Mascarenhas; National Renewable Energy Laboratory, Golden
- 534 *Probing Structure/Property Relationships of Ce-Rich Oxygen Evolution Catalysts by Advanced Transmission Electron Microscopy*; C Kisielowski, Y Cai, Lawrence Berkeley National Laboratory; JA Haber, JM Gregoire; Joint Center for Artificial Photosynthesis (JCAP)
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- 542 *Three-Dimensional Arrangement and Connectivity of Lead-Chalcogenide Nanoparticle Assemblies for Next Generation Photovoltaics*; BH Savitzky, K Whitham, K Bian, R Hovden, T Hanrath, LF Kourkoutis; Cornell University, Ithaca
- 544 *Effects of Focused-Ion-Beam Processing on Local Electrical Measurements of Inorganic Solar Cells*; HP Yoon, PM Haney, J Schumacher, K Siebein, Y Yoon, NB Zhitenev; National Institute of Standards and Technology, Gaithersburg; HP Yoon, Y Yoon; University of Maryland, College Park

- 546 *Duplex Nanostructured TiO<sub>2</sub> Powder*; AK Al-Kamal, JF Al-Sharab, H Halim, G Xiong, BH Kear, SD Tse; Rutgers University, Piscataway
- 548 *Spatial Distribution of Light Scattering and Absorption Interactions with TiO<sub>2</sub>-Nanoparticles from Monte Carlo and Generalized-Multiparticle-Mie based Simulations for Dye-Sensitized Solar Cell Analysis and Optimization*; I Carvajal, GP Demopoulos, R Gauvin; McGill University, Canada
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- 552 *Using Electron Channeling Contrast Imaging for Misfit Dislocation Characterization in Heteroepitaxial III-V/Si Thin Films*; J Deitz, S Carnevale, SA Ringel, T Grassman, DW McComb; The Ohio State University; M De Graef, Y Picard; Carnegie Mellon University, Pittsburgh
- 554 *Microscopic Investigation of Mono-layer/Multi-layer Self-assembled InAs QDs on GaAs<sub>1-x</sub>Sb<sub>x</sub>/GaAs Composite Substrates for Photovoltaic Solar Cells*; D Tang, Y Kim, N Faleev, C Honsberg, DJ Smith; Arizona State University, Tempe

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- 558 *Energy-Filtered High-Angle Dark Field Mapping of Ultra-Light Elements*; TC Lovejoy, N Dellby, GJ Corbin, P Hrnčirik, ZS Szilagy, OL Krivanek; Nion Co, Kirkland; T Aoki; Arizona State University, Tempe
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- 562 *Atomic-Scale STEM-EELS Characterization of the Chemistry of Structural Defects and Interfaces in Energy-Related Materials*; QM Ramasse, DM Kepaptsoglou; SuperSTEM Laboratory, UK; F Azough, R Freer; University of Manchester, UK; R Mainz, A Webber, D Abou-Ras; Helmholtz Zentrum Berlin, Germany; E Simsek, PA van Aken; Max Planck Institute for Intelligent Systems, Germany
- 564 *XEDS in the AEM: Has Everything Thing That Can be Invented, Been Invented?*; NJ Zaluzec; Argonne National Laboratory

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- 574 *Tunable Plasmon and Optical Properties of Chalcogenide Nanoplates Using Monochromated Electron Energy Loss Spectroscopy*; D Kong, M L Brongersma, Y Cui, KCY Huang, S Fan, KX Wang; Stanford University; JJ Cha; Yale University; KJ Koski; Brown University, Providence; W Luo; Shanghai Jiao Tong University, China; Z Yu; University of Wisconsin-Madison, Madison
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- 578 *Electron Energy Loss Spectroscopy and Localized Cathodoluminescence Characterization of GaN Quantum Discs*; REA Williams, SD Carnivale, TF Kent, RC Myers, DW McComb; The Ohio State University; DJ Stowe, Gatan UK Abingdon, United Kingdom
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- 586 *Atomic Column Elemental Mapping by STEM-Moiré Method*; E Okunishi, N Endo, Y Kondo; JEOL Ltd, Japan
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- 590 *High Resolution Optical and Vibrational Spectroscopy with Low Loss EELS*; P Cueva, DA Muller; Cornell University; DA Muller; Kavli Institute at Cornell for Nanoscale Science, Ithaca
- 592 *The Role of Cation Intermixing, Interfacial Chemistry, and Oxygen Deficiency in Understanding the Properties of the LaFeO<sub>3</sub>/SrTiO<sub>3</sub>(100) Interface*; R Colby, B Kabius; Environmental Molecular Sciences Laboratory, Richland; KHL Zhang, SA Chambers; Pacific Northwest National Laboratory; A Genc, L Pullan; FEI Company, Hillsboro
- 594 *Methods for Scanning Transmission Electron Microscopy High Angle Annular Dark Field Based for Three Dimensional Analysis of the Local Composition in Solid Alloys*; E Rotunno; CNR-IMEM, Italy; V Grillo; CNR-Istituto Nanoscienze, Italy; T Markurt, T Remmele, M Albrecht; Leibniz Institute for Crystal Growth, Germany
- 596 *Structure Analysis of a Hyper-Complex Approximant to Icosahedral Quasicrystal using 3D Electron Diffraction Tomography*; P Oleynikov, Y Ma, O Terasaki; Stockholm University, Sweden; N Fujita, AP Tsai; Tohoku University, Japan; J Garcia-Garcia; Universidad Complutense de Madrid, Spain; KB Yoon; Sogang University, Republic of Korea; O Terasaki; Graduate School of EEWS, Republic of Korea
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- 600 *Investigation of Surface Plasmon Coupling and Damping in Au and Ag Nanoparticle Assemblies by Monochromated Electron Energy Loss Spectroscopy*; AM Thron, A Polyakov, PJ Schuck, S Aloni; Lawrence Berkeley National Laboratory
- 602 *Electron-Energy Loss and Optical Spectroscopy of Hybrid Nanogap-Antennas on Different Substrates*; T. Brintlinger, J. P. Long, R. M. Stroud, I. Vurgaftman, B. S. Simpkins; U. S. Naval Research Laboratory; A. A. Herzing; National Institute of Standards and Technology
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- 888 *Influence of Cooling Rate on Corrosion Resistance of the A383 Aluminum to Biofuels E10, E30 and E100*; M. Santos-Beltrán, A. Santos-Beltrán, V. Gallegos-Orozco, Universidad Tecnológica Junta de los Ríos, México; V. Gallegos-Orozco, C. Rodríguez-González; Universidad Autónoma de Cd. Juárez (UACJ), México; A. Santos-Beltrán, R. Martínez-Sánchez; Centro de Investigación en Materiales Avanzados (CIMAV), México
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- 1060 *Experimental Evidence of Chiral Gold Nanowires with Boerdijk-Coxeter-Bernal Structure by Atomic-Resolution Imaging*; Y. Zhu, X. Miao, J. Huang, Y. Han; King Abdullah University of Science and Technology, Saudi Arabia; J. He, H. Chen; Nanyang Technological University, Singapore; C. Shang, Z. Liu; Fudan University, China
- 1062 *Three-Dimensional Imaging of Dislocations and Defects in Materials at Atomic Resolution Using Electron Tomography*; J. Miao, C.-C. Chen, M. C. Scott, C. Zhu, M. Mecklenburg, E. R. White, C.-Y. Chiu, B. C. Regan, Y. Huang; University of California; P. Ercius, U. Dahmen; Lawrence Berkeley National Laboratory; L. D. Marks; Northwestern University
- 1064 *Electron Channeling Contrast Imaging for Non-Destructive Analysis of Extended Defects in Semiconductor Thin Films and Device Structures*; M. B. Katz, M. E. Twigg, S. I. Maximenko, N. D. Bassim, N. A. Mahadik, G. G. Jernigan, C. L. Canedy, J. Abell, C. A. Affouda; United States Naval Research Laboratory
- 1066 *Applications of Automated High Resolution Strain Mapping in TEM on the Study of Strain Distribution in MOSFETs*; A. D. Darbal, R. D. Narayan, J. K. Weiss; AppFive LLC; C. Vartuli; Texas Instruments; T. Aoki, J. Mardinly; Arizona State University; A. D. Darbal, S. Nicolopoulos; NanoMEGAS SPRL, Belgium
- 1068 *Accuracy of Strain in Strain Maps Improved by Averaging Multiple Maps*; N. Endo, Y. Kondo, JEOL Ltd, Japan
- 1070 *Strain Quantification Analysis of Epitaxial SiGe on SOI by Nanobeam Diffraction (NBD)*; J. Li, K. Cheng, A. Khakifirooz, J. Wang, A. Reznicek, B. Doris, H. He, J. Gaudiello; IBM; A. Madan; IBM SRDC; N. Loubet; STMicroelectronics
- 1072 *Measurement of Local Atomic Displacements Reveals Interaction of Au Nanocrystals with Rutile (TiO<sub>2</sub>) Surface Steps*; W. Gao, J.-M. Zuo; University of Illinois
- 1074 *Atomic Resolution Study of Local Strains in Doped VO<sub>2</sub> Nanowires*; H. Asayesh-Ardakani, A. Nie, G. M. Odegard, R. Shahbazian-Yassar; Michigan Technological University; H. Asayesh-Ardakani, A. Nie, P. J. Philips, R. F. Klie, R. Shahbazian-Yassar, K.-b. Low, F. Mashayek; University of Illinois at Chicago; P. M. Marley, S. Singh, G. Sambandamurthy, S. Banerjee; State University of New York



- 1076 *Strain Associated with Surface-Penetrating Dislocations Visible by Electron Channeling Contrast Imaging*; M. Liu, Y. N. Picard; Carnegie Mellon University
- 1078 *Ad Hoc Determination of Local Misorientations and Boundary Planes between Grains in TEM by a Dedicated Software Package Developed for the Gatan DigitalMicrograph Platform*; C. A. Wade, M. Watanabe; Lehigh University
- 1080 *Investigation of Bi Segregation of Cu Bicrystal Boundaries Using Aberration-Corrected STEM Depth Sectioning*; C. A. Wade, M. Watanabe; Lehigh University
- 1082 *Observations on Heavily Deformed Tantalum*; M. T. Janish, C. B. Carter, University of Connecticut; P. G. Kotula, B. L. Boyce; Sandia National Laboratories
- 1084 *Atomic-Scale Observation of Grains and Grain Boundaries in Monolayers of WS<sub>2</sub>*; A. Azizi, A. L. Elias, N. Perea-López, M. Terrones, N. Alem; The Pennsylvania State University; X. Zou, Z. Zhang, B. I. Yakobson; Rice University; P. Ercuis; Lawrence Berkeley National Laboratory
- 1086 *Imaging Defects in Quantum Materials*; D. C. Bell, E. Kalfon-Cohen; Harvard University
- 1088 *An Electron Microscopic Investigation of (1/3)<0 11 1> Dislocations in Bi<sub>2</sub>Te<sub>3</sub> Nanowires: Defect Crystallography and Relationship to 7-Layer Bi<sub>3</sub>Te<sub>4</sub> Defects*; D. L. Medlin, K. J. Erickson, S. J. Limmer, W. G. Yelton, M. P. Siegal; Sandia National Laboratories

### ***Vendor Symposium: New Tools for Life and Materials Sciences***

- 1090 *Applications and Design of Reinforced Silicon Nitride Windows for In Situ Liquid Transmission Electron Microscopy*; M. J. Dukes, R. Thomas, J. Damiano; Protochips, Inc; A. D. Dukes, III; Lander University; K. L. Klein; University of the District of Columbia; D. F. Kelly; Virginia Tech Carilion Research Institute
- 1092 *TAG Lens: Revolutionizing Optical Microscopy With Ultra-High Speed Variable Focus*; C. Theriault, J. Guttenfelder, C. B. Arnold; TAG Optics Inc; C. B. Arnold; Princeton University
- 1094 *A Novel Compact Stand-Alone FTIR Microscope for the Analysis of Small Samples*; T. J. Tague Jr; Bruker Optics, Inc
- 1096 *Rapid, High-Resolution Raman Imaging of Pharmaceutical, Biological, and Other Materials with the Thermo Scientific DXRxi*; R. A. Heintz, M. H. Wall, J. L. Ramirez; Thermo Fisher Scientific
- 1098 *The Unique Capabilities of Auger Electron Spectroscopy*; R. A. Price, J. F. Moulder, D. F. Paul, J. S. Hammond; Physical Electronics
- 1100 *Secondary Electron Imaging in the Helium Ion Microscope*; B. Matola; Denison University; D. C. Joy; University of Tennessee
- 1102 *Optimized Electron Column and Detection Scheme for Advanced Imaging and Analysis of Metals*; D Wall, F Cyril-Sasam; FEI Company, The Netherlands; T Vystavel, P Wandrol; FEI Company, Czech Republic

- 1104 *New High-Resolution Low-Voltage and High Performance Analytical FIB/SEM System*; J Jiruše, M Havelka, M Haničinec, J Polster, T Hrnčíř; TESCAN Brno, Czech Republic
- 1106 *Automated SEM Analysis in Industrial Process Control and Scientific Research*; C Lang, A Hyde, M Hiscock, S Burgess, J Holland, P Statham; Oxford Instruments Nano Analysis, UK
- 1108 *Using Nion Swift For Data Collection, Analysis and Display*; CE Meyer, N Dellby, Z Dellby, GS Skone, OL Krivanek; Nion Co.
- 1110 *Enabling Future Nanotomography and Nanofabrication with Crossbeam Technology*; I Schulmeyer, M Kienle; Carl Zeiss Microscopy GmbH, Germany
- 1112 *AFM Integrated with SEM/FIB for Complete 3D Metrology Measurements*; A Lewis; The Hebrew University of Jerusalem, Israel; A Komissar, A Ignatov, O Fedoroyov, E Maayan; Nanonics Imaging Ltd; Israel; D Yablon; SurfaceChar LLC., Sharon MA
- 1114 *Image Collection using an Auto Data Acquisition System and An Application to Ice Embedded Ribosome*; Y Aoyama, H Nishioka, Y Kondo, JEOL Ltd., Japan
- 1116 *A New Microstructural Imaging Approach Through EBSD Pattern Region of Interest Analysis*; MM Nowell, SI Wright; EDAX Inc.; T Rampton; EDAX Inc.; R de Kloe; EDAX B.V, The Netherlands
- 1118 *Concepts for an Annular Pole Piece Detector for the Simultaneous Measurement of X-Rays and Backscattered Electrons Inside a SEM*; A Liebel, R Eckhardt, M Bornschlegl, A Bechteler, A Niculae, H Soltau; PNDetector GmbH, Germany
- 1120 *Performance Advances in LEAP Systems*; RM Ulfig, DJ Larson, TF Kelly, PH Clifton, TJ Prosa, DR Lenz, EX Oltman; CAMECA Instruments Inc.
- 1122 *The pnCCD for Applications in Transmission Electron Microscopy: Further Development and New Operation Modes*; R Henning, R Hartmann, M Huth, S Ihle, J Schmidt, L Strüder; PNSensor GmbH, Germany; M Simson, H Soltau; PNDetector GmbH, Germany
- 1124 *Large Solid Angle Silicon Drift Detectors for EDX Analysis in TEM*; A Niculae, M Bornschlegl, R Eckhardt, J Herrmann, S Jeschke, G Krenz, A Liebel, H Soltau; PNDetector GmbH, Germany; G Lutz, L Strüder; PNSensor GmbH, Germany
- 1126 *Are EDS Specifications Still Relevant*; K Thompson; Thermo Fisher Scientific
- 1128 *Introduction of a New Conventional SEM: JSM-IT300LV: The Observation of a Water Containing Specimen With a Cooling Stage at 650 Pa*; N Inoue, T Kaneko, K Kawauchi; JEOL Ltd., JAPAN; D Edwards, D Guarrera; JEOL USA Inc.
- 1130 *Advancements in Decontamination of Vacuum Systems Using Plasma Cleaning*; R Vane, CA Moore; XEI Scientific
- 1132 *Measurement of Downstream Charge Transport During Plasma Cleaning of Vacuum Chambers*; CA Moore; XEI Scientific

- 1134 *New X-ray Transparent and Light Tight Windows for EDS Detectors*; M Bornschlegl, A Niculae, H Soltau, R Eckhardt, K Hermenau; PNDetector GmbH, Germany
- 1136 *Geochemical Evaluation of Geopressured Geothermal Wellbore Cement*; K Bello, M Radonjic; Louisiana State University
- 1138 *Atomic Resolution Characterization of Ni-base Nanoparticles for Energy Devices*; HA Calderon; ESFM-IPN, Mexico; F Godinez-Salomon, O Solorza-Feria; CINVESTAV, Mexico; P Specht; Lawrence Berkeley National Laboratory; C Kisielowski; University of California-Berkeley
- 1140 *Functionalized Surfaces to Improve Imaging Conditions in Liquid Cell Transmission Electron Microscopy*; JM Miller, JE Hutchison; Dune Sciences; DH Alsem, N Salmon; Hummingbird Scientific; NE Johnson, JE Hutchison; University of Oregon
- 1142 *A New In-situ Broad Ion Beam, With Energy Range 1 – 500 eV*; JJJ Mulders; PHF Trompenaars; EGT Bosch, RTJP Geurts; FEI Company, The Netherlands
- 1144 *On the Characterization of the Geometrical Collection Efficiency of Modern EDS Systems*; R Terborg, M Falke, A Käppel; Bruker Nano GmbH, Germany; V-D Hodoroaba; BAM Federal Institute for Materials Research and Testing, Germany
- 1146 *Ultrahigh-Resolution X-ray Microanalysis with a Cryogen-Free Microcalorimeter Spectrometer*; R Cantor; STAR Cryoelectronics; H. Naito; H.K.N. Inc.
- 1148 *Solid State Backscattered Electron Detectors with Improved Image Contrast and Detection Speed*; A Liebel, R Eckhardt, A Niculae, H Soltau; PNDetector GmbH, Germany
- 1150 *A Double Silicon Drift Type Detector System for EDS with Ultrahigh Efficiency and Throughput for TEM*; S Kawai, I Onishi, T Ishikawa, K Yagi, T Iwama, K Miyatake, Y Iwasawa, M Matsushita, T Kaneyama, Y Kondo; JEOL Ltd., Japan
- 1152 *Development of Au-GCIB Dynamic SIMS and Cluster Size Filtering System*; M Nojima, M Suzuki, T Adachi; Tokyo University of Science, Chiba; S Hotta; Office Tandem. LCC., Tokyo; M Fujii, T Seki; J Matsuo; Kyoto University, Kyoto
- 1154 *Observation of Wet Samples Using a Novel Atmospheric Scanning Electron Microscope*; Y Ominami, S Kawanishi, S Ito; Hitachi High-Technologies Corporation, Japan; T Ushiki; Niigata University Graduate School of Medical and Dental Sciences, Japan
- 1156 *High-Flux Monochromatic Electron and Ion Beams from Laser Cooled Atoms*; A McCulloch, Y Bruneau, G Khalili, D Comparat; Laboratoire Aimé Cotton, France
- 1158 *Typhon: Multiplexed TEM Sample Preparation*; S Mulligan, T Jain, JA Speir, A Cheng, B Carragher, CS Potter; The Scripps Research Institute; E Duggan, E Liu, J Nolan; La Jolla Bioengineering Institute
- 1160 *Measurement of Detection Efficiency in Atom Probe Tomography*; T. J. Prosa, B. P. Geiser, R. M. Ulfing, T. F. Kelly, D. J. Larson; CAMECA Instruments

## ***Dr. Gerard Simon Memorial Symposium on Anatomic Pathology***

- 1162 *Gérard T. Simon, a Visionary of Microscopy in Canada*; Pierre M. Charest; Université Laval, Canada
- 1164 *Look Closely: Lessons Prof. Gérard T. Simon Might Have Taught*; David N. Howell; Duke University and Veterans Affairs Medical Centers
- 1166 *Discovery of New Nucleo Cytoplasmic Large Deoxiriboviruses by Transmission Electron Microscopy*; A. P. Alves de Matos; Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Portugal; A. P. Alves de Matos, M. F. Caeiro; Centro de Estudos do Ambiente e do Mar (CESAM/FCUL), Portugal; Rachel E. Marschang; Laboklin GmbH & Co. KG, Germany; Ilan Paperna; Food and Environmental Quality Sciences of the Hebrew University of Jerusalem, Israel
- 1168 *Fifty Shades of Ultrastructural Pathology in One Thousand Sural Nerves*; Juan M. Bilbao; University of Toronto
- 1170 *Diagnostic Art: A Tribute to Professor Gérard Simon*; J. Allan Tucker; University of South Alabama
- 1172 *Electron Microscopy of Suspicious Samples and Infectious Specimens: Research and Diagnostics*; D. R. Beniac, T. F. Booth; National Microbiology Laboratory, Canada

## ***Microbes and Microbial Communities***

- 1174 *Quantitative Single-Cell Gene Expression Measurements in Bacteria Using Time-Lapse Microscopy*; Mary J. Dunlop; University of Vermont
- 1176 *Probing Magnetic Polarities of Magnetotactic Bacteria by X-ray Magnetic Circular Dichroism in a Scanning Transmission X-ray Microscope*; X. H. Zhu, A. P. Hitchcock; McMaster University, Canada; T. Tyliczszak; LBNL; D. A. Bazylnski; University of Nevada
- 1178 *Chemical Imaging of Biofilms: The Integration of Synchrotron Imaging, Electron Microscopy and Nuclear Magnetic Resonance (NMR) Technologies*; M. J. Marshall, S. M. Belchik, A. E. Tucker, W. B. Chrisler, M. Thomas, R. S. Renslow, A. P. Kuprat, A. C. Dohnalkova; Pacific Northwest National Laboratory; C. J. Hirschmugl; Synchrotron Radiation Center
- 1180 *Three Dimensional Visualization of Bacterial Type III Export Apparatus in the Lyme Disease Spirochete *Borrelia burgdorferi**; J Tu, X Zhao, SJ Nortis, J Liu; University of Texas, Houston; A Manne, K Lees, Md A Motaleb; East Carolina University, Greenville; K Zhang, C Li; University of New York at Buffalo
- 1182 *Analyzing Secondary Metabolite Production by 3D Printed Bacterial Populations Using Scanning Electrochemical Microscopy*; J Connell, J Kim, JB Shear, AJ Bard, M Whiteley; University of Texas at Austin
- 1184 *Staphylococcal Colonization of E-Beam Patterned Surfaces*; Y Wang, M Libera; Stevens Institute of Technology; J da Silva Domingues, G Subbiahdoss, HC van der Mei, HJ Busscher; University Medical Center Groningen; Y Wang; US Food and Drug Administration

- 1186 *High Resolution Electron and Ion Microscopy of Photosynthetic Complexes*; BW Arey, AC Dohnalkova, DW Koppenaal; Pacific Northwest National Laboratory; M Liberton, HB Pakrasi; Washington University
- 1188 *Spatial Distribution of Respiratory Metabolisms in Lab-Grown and in vivo Pseudomonas aeruginosa Biofilms*; RC Hunter; University of Minnesota Medical School
- 1190 *Adhesion of A. actinomycetemcomitans to Host Components of the Extracellular Matrix*; F Azari, M Radermacher, K Mintz, T Ruiz; University of Vermont
- 1192 *Correlative Imaging and Analyses of Soil Organic Matter in the Rhizosphere*; AC Dohnalkova, T Varga; Pacific Northwest National Laboratory; CK Keller; Washington State University
- 1194 *Non Spore-Forming Bacteria: Sterility and Ultrastructure Study*; RM Hannah, C A Brantner, JP Burans, RK Pope; National Biodefense Analysis and Countermeasures Center

### ***Nuclear Architecture and Chromatin Structure: 40 Years after the Nucleosome***

- 1196 *Protein Interaction and Transport Maps of Live Cell Nuclei Using Fluorescence Correlation Spectroscopy in a Single Plane Illumination Microscope*; JW Krieger, A Pernus, J Langowski; German Cancer Research Center, Germany; P Brazda; University of Debrecen, Hungary
- 1198 *Heterochromatin Domains: Uncoupling Epigenetic Modifications and Chromatin Structural Parameters*; E Fussner; The Lunenfeld-Tanenbaum Research Institute, Canada; M Strauss; Harvard Medical School; R Li, Z Baghestani, DP Bazett-Jones; The Hospital for Sick Children, Canada
- 1200 *Large-scale Chromatin Structure and Dynamics: a Combined Structural and Molecular Approach*; X Deng, G Sustackova, Y Chen, N Khanna, AS Belmont; University of Illinois
- 1202 *ELCS in Ice: Cryo-electron Microscopy of Nuclear Envelope-Limited Chromatin Sheets*; M Eltsov; European Molecular Biology Laboratory, Germany; S Sosnovski; Neurophysiology & New Microscopies Laboratory, France; AL Olins, DE Olins; University of New England
- 1204 *How Histone Modifications Change Nucleosome Stability - FRET Studies on Single Molecules and in Bulk*; K Tóth, A Gansen, J Langowski; German Cancer Research Center, Germany; S Hetey, L Székvölgyi; University of Debrecen, Hungary; L Nordenskiöld; Nanyang Technological University, Singapore

### ***Advances in Sample Preparation for Cryo-EM Studies***

- 1206 *Cryo-Electron Microscopy of Potassium Channel Membrane Proteins*; J Kowal, S Scherer, K Sejwal, M Chami, P Baumgartner, H Stahlberg; University of Basel, Switzerland; M Rangl, S Scheuring; Aix-Marseille Université, France; GF Schröder; Heinrich-Heine University Düsseldorf, Germany; C Nimigean; Weill Cornell Medical College
- 1208 *One and Two Dimensional Arrays of Membrane Proteins Stabilized by Amphipol*; W Arunmanee, JR Harris, JH Lakey; Newcastle University; JR Harris; University of Mainz, Germany

- 1210 *Two-Dimensional Crystallization of Membrane Proteins: Screening Strategies*; N Coudray, R Lasala, Z Zhang, D Stokes; New York Structural Biology Center; Z Zolnai; University of Wisconsin-Madison; I Ubarretxena; Mt. Sinai School of Medicine; D Stokes; NYU School of Medicine
- 1212 *Study of Membrane Proteins by Single Particles Electron Microscopy Using Detergent, Liposomes and Nanodiscs*; L Fabre, D Mountassif, I Rouiller; McGill University, Canada; H Bao, F Duong; University of British Columbia, Canada
- 1214 *Modifying Graphene Substrates for Imaging Proteins in a Transmission Electron Microscope*; C J Russo, LA Passmore; Medical Research Council Laboratory of Molecular Biology, United Kingdom
- 1216 *Quantitative Correlative Light and Electron Microscopies; Targeting the Host Actin Cytoskeleton*; N Volkmann, D Hanein; Sanford Burnham Medical Research Institute
- 1218 *Macromolecular Dynamics by Hybrid Electron Microscopy Normal Mode Analysis*; Q Jin, S Jonic; Sorbonne Universités - CNRS UMR 7590; COS Sorzano, JM de la Rosa-Trevín; Centro Nacional de Biotecnología— CSIC, Spain; F Tama; Advanced Institute for Computational Sciences, Hyogo
- 1220 *Immunogold Labeling of Cultured Cells and Virus Particles for Electron Microscopy and Cryo-Electron Microscopy Applications*; H Yi, RD Shetty, RR Amara, ER Wright; Emory University; JD Strauss, JE Hammonds, PW Spearman, ER Wright; Emory University School of Medicine
- 1222 *Structural Cell Biology: Preparing Specimens for Cryo-Electron Tomography Using Focused-Ion-Beam Milling*; E. Villa; University of California San Diego; E. Villa, M Schaffer, J Plitzko, B Engel, W Baumeister; Max Planck Institute of Biochemistry, Germany; J Plitzko; Utrecht University, The Netherlands
- 1224 *Cryogenic FIB Lift-out as a Preparation Method for Damage-Free Soft Matter TEM Imaging*; C Parmenter, M Fay; University of Nottingham, UK; C Hartfield, G Amador; Oxford Instruments Nanoanalysis; G Moldovan; Oxford Instruments Nanoanalysis, UK
- 1226 *Simultaneous Imaging of Cryo-Bright Field, Dark Field STEM and SEM Using Unroofed Living Cells with Special Reference to Membrane Cytoskeletons*; J Usukura, S Minakata; Nagoya University, Japan
- 1228 *Reorganization of S. aureus ECM during Cryo-Preparation for SEM Imaging*; Y Wu, J Liang, T-M Chou, M Libera; Stevens Institute of Technology; K Rensing; Leica Microsystems Inc.
- 1230 *Comparison of Classical SEM and ESEM Protocols for Study of Conifer Embryogenic Tissues with Using Low Temperature Conditions of ESEM.*; V. Neděla, E Tihlaříkova, J Hřib, J Runštuk; Institute of Scientific Instruments of the ASCR, Czech Republic
- 1232 *Cryo-SEM of Perpendicular Cross Freeze-Fractures Through a High-Pressure-Frozen Biofilm*; V Krzyzanek, K Hrubanova; Institute of Scientific Instrument ASCR, Czech Republic; K Hrubanova; Brno University of Technology, Czech Republic; J Nebesarova; Biology Center ASCR, Czech Republic; F Ruzicka; Masaryk University, Czech Republic
- 1234 *Comparative TEM Studies of Liquid Crystals: Freeze Fracture, Plunge Freezing of Thin Films, and Cryosectioning of Bulk Samples*; M Gao; Kent State University

- 1236 *Improving Sample Preparation Methods to Assess Nanoparticle Agglomeration using TEM*; J Zheng; Food and Drug Administration
- 1238 *Cryo-Electron Microscopy of Latex-Pigment Composites for Enhanced Hiding in Latex Paints*; JR Reffner, J Bohling, M Keefe; Dow Chemical Company

## ***Structural Biology and Ultrastructure***

- 1240 *Towards a General Protocol to Form Single-Layered 2D Crystal Sheets of Membrane Proteins for Electron Crystallography*; MC Johnson, I Schmidt-Krey; Georgia Institute of Technology; MC Johnson; Florida State University
- 1242 *Solving Protein Nanocrystals by Cryo-EM: Multiple Scattering Artifacts*; G Subramanian, S Basu, H Liu, JCH Spence; Arizona State University; J M Zuo; University of Illinois
- 1244 *Phage Capsid-like Structure of Myxococcus xanthus Encapsulin, a Protein Shell That Stores Iron*; J Fontana, D Nemecek, AA Aksyuk, N Cheng, DC Winkler, JB Heymann, AC Steven; National Institute of Arthritis and Musculoskeletal and Skin Diseases; CA McHugh, E Hoiczky; Johns Hopkins University
- 1246 *Deciphering the 3D Structure and Function of Phosphofructokinase from Fission Yeast*; S Benjamin, M Radermacher, T Ruiz; University of Vermont
- 1248 *Turning a Liability into an Asset: Radiation Damage as a Cytochemical Marker*; N Cheng, W Wu, NR Watts, J Fontana, AC Steven, National Institute of Arthritis, Musculoskeletal and Skin Diseases
- 1250 *Seeing the Portal in Membrane-containing Bacteriophage PRD1 by Cryo-EM*; C Hong, X Liu, J Jakana, W Chiu; Baylor College of Medicine; HM Oksanen, DH Bamford; University of Helsinki, Finland
- 1252 *Structure of the Yeast Mitochondrial Large Ribosomal Subunit*; A Amunts, A Brown, X-C Bai, JL Ll acer, T Hussain, P Emsley, F Long, G Murshudov, SHW Scheres, V Ramakrishnan; Laboratory of Molecular Biology, UK
- 1254 *ResLog Plots: A New Metric for the Quality of Cryo-EM Reconstructions*; SM Stagg, AJ Noble, M Spilman; Florida State University; M Chapman; Oregon Health & Science University
- 1256 *Structural Characterization of Tethered HIV-1 VLPs by Light Microscopy and Cryo-Electron Tomography*; JD Strauss, JE Hammonds, PW Spearman, ER Wright; Emory University School of Medicine
- 1258 *Automated Procedures for the Alignment and Reconstruction of Multiple Tilt Electron Microscopic Tomography Data*; M H Ellisman, D Boassa, P Nguyen, X Wan, A Lawrence, S Phan; University of California San Diego; J Lanman; Purdue University
- 1260 *Giardia lamblia's Ventral Disc Microtubules Transition Through as Many as Six Structurally Distinct Regions*; CL Schwartz, JR Brown, JM Heumann, A Hoenger; University of Colorado; SC Dawson; University of California

- 1262 *In Situ FtsZ Mini-Ring Structure Revealed by TEM Tomography and STEM*; Carol B. Johnson, Zheng Long, Aaron G. Smith, Zhiping Luo, Stanislav Vitha, Andreas Holzenburg; Texas A&M University
- 1264 *BMP Signaling Regulates Extracellular Matrix Composition and Permeability in C. elegans*; RD Schultz, TL Gumienny; Texas A&M University Health Science Center; EA Ellis; Texas A&M University
- 1266 *New Method for Multiple Immunodetection on Resin Ultrathin Section in the Field Emission Scanning Electron Microscope*; P Wandrol; FEI Czech Republic, Czech Republic; M Vancová, J Nebesářová; Institute of Parasitology, Biological Centre of ASCR, Czech Republic; M Vancová; University of South Bohemia, Czech Republic; J Nebesářová; Charles University in Prague, Czech Republic
- 1268 *The New EM: Specimen Preparation Procedures for Resin Embedding of Cryofixed Biological Samples in 6 Hours (Without a Microwave)*; KL McDonald; University of California
- 1270 *Investigation of Electron Beam Induced Mass Loss of Embedding Media in the Low Voltage STEM*; V Novotna, K Hrubanova, V Krzyzanek; Institute of Scientific Instrument ASCR, Czech Republic; V Novotna, K Hrubanova; Brno University of Technology, Czech Republic; J Nebesarova, Biology Center ASCR, Czech Republic
- 1272 *Vesicular Diversity and Crowding Within the Olfactory Sensory Receptor Neuron*; SK De, SK Sarkar; Vidyasagar University, India
- 1274 *Light and Electron Microscopic Study of Soft Bone Osteocytes From a Triceratops horridus Supraorbital Horn*; M H Armitage; CRS Microscopy Laboratory; KL Anderson; Arkansas State University, Beebe
- 1276 *Aspects of Chemical Composition of Exodermal Cell Walls in Roots of Ni-Hyperaccumulating and Non-Hyperaccumulating Genotypes of Senecio coronatus*; J Mesjasz-Przybyłowicz, AD Barnabas, TP Sechogela, WJ Przybyłowicz; iThemba LABS, South Africa; I Yousef, P Dumas, F Jamme; Soleil Synchrotron, France; WJ Przybyłowicz; AGH University of Science and Technology, Poland
- 1278 *Matching Anatomies - Correlating Pollen Tube Anatomy with Pistillar Geometry*; Y Chebli, M Baselizadeh, A Geitmann; Université de Montréal, Montreal
- 1280 *A Comparative Study of the Sensory Structures Among Three Basal Hexapod Clades (Arthropoda: Collembola, Protura, Diplura) Using Scanning Electron Micrographs*; RT Allen, A Lawrence, RL Brown; Mississippi State University
- 1282 *Investigation of Escherichia coli Selenocysteine Synthase (Sela) Complex Formation Using Cryo-Electron Microscopy (Cryo-EM)*; VH Balasco Serrão, LR Manzine, I Rosa e Silva, OH Thiemann; University of São Paulo; A Cassago, J Bettini, R Villares Portugal; LNNano-CNPEN; M van Heel; NeCEN - Leiden Universiteit
- 1284 *Cryo-Electron Microscopic Study of the Enzymatic Mechanism of the RNA 2'-O-Methyltransferase Box C/D sRNP*; WS Vincent Yip, H Shigematsu, SJ Baserga; Yale University; DW Taylor; University of California; H-W Wang; Tsinghua University, China



- 1286 *Cantharidin an Active Compound of Blister Beetle Caused Mitochondrial Damage and Induced Apoptosis, Necrosis and Autophagy in Dalton's Ascites Lymphoma in vivo*; AK Verma, SB Prasad; North- Eastern Hill University, India; AK Verma; Cachar Cancer Hospital & Research Centre, India
- 1288 *High Throughput Multi Parameter TEM Chemical Processing Protocol Development with the mPrep-s Capsule System: Schmidtea mediterranea*; M McClain; Stowers Institute for Medical Research
- 1290 *Structure and Development of the Attractive and Digestive Glands in the Carnivorous Pitcher Plant Nepenthes alata*; TP Owen, A Carini, L Sutherland, C Hass, K Gabow; Connecticut College, L Sutherland; University of Maryland School of Medicine, C Hass; Boston Children's Hospital
- 1292 *Ultrastructure of Mitosis and Spindle Pole Bodies in the Zygomycetous Fungus Coemansia reversa Using Conventional Fixation and Freeze Substitution*; RA Healy, G J Celio, DJ McLaughlin; University of Minnesota; TKA Kumar; The Zamorin's Guruvayurappan College, India; RW Roberson; Arizona State University
- 1294 *Identification of Isolated and in situ Freshwater Sponge Spicules of Eastern Tennessee*; SC Kunigelis, JE Copeland; Lincoln Memorial University
- 1296 *Antiproliferative and Apoptotic Effects of Vanadyl Sulphate on H-Ras Transformed 5rp7 Cells*; M Kutlu, D Veyselova; Anadolu University, Turkey

## ***Microanalysis of Biological Materials***

- 1298 *Compositional Imaging of Cells and Bionanoparticles by EFTEM*; MA Aronova, RD Leapman; Laboratory of Cellular Imaging & Macromolecular Biophysics
- 1300 *Quantifying Nanoparticle-Cell Interactions*; N Hondow, A Brown, R Brydson; University of Leeds, UK; HD Summers, MR Brown, P Rees, MD Holton; Swansea University, UK
- 1302 *High Speed EELS and EFTEM Analysis Across the Visual Cortex*; P Longo, RD Twesten; Gatan Inc; W Lin; Mayo Clinic
- 1304 *Revealing the Secrets of Strong Iron Enrichment in Hard Dental Tissues from Feral Coypu (Myocastor coypus) by Analytical (S)TEM*; V Srot, U Salzberger, B Bussmann, PA van Aken; Max Planck Institute for Intelligent Systems, Germany; B Pokorny, I Jelenko; ERICo Velenje; Environmental Protection College, Slovenia
- 1306 *Biological X-ray Fluorescence Microscopy: Advances and Unique Opportunities*; S Vogt, S-C Gleber, S Chen, L Finney, C Jacobsen; Argonne National Laboratory; Q Jin, C Jacobsen; Northwestern University; M Ralle; Oregon Health & Science University; C Fahrni; Georgia Institute of Technology; D Mustafi; University of Chicago
- 1308 *Correlative X-ray and Electron Spectroscopy of the Materials-Biology Interface Reveals Insights into Impact of Engineered Nanomaterials on Human Physiology*; AE Porter; Imperial College London, UK

- 1310 *Microscopy and Microanalysis of Mineral Particles in Lung Biopsies of Iraq and Afghanistan Deployers, Normal Controls, and Autoimmune Lung Disease Controls*; H Lowers, T Todorov, G Breit, GP Meeker, GS Plumlee; US Geological Survey; M Robinson, R Meehan, G Cosgrove, M Strand, S Dhoma, S Groshong, C Rose; National Jewish Health; University of Colorado Anschutz Medical Campus; R Miller; Vanderbilt University
- 1312 *An In Ovo Investigation of the Ultrastructural Effects of the Heavy Metals Cadmium and Chromium on Liver Tissue*; C Venter, HM Oberholzer, H Taute, MJ Bester, CF van der Merwe; University of Pretoria, South Africa
- 1314 *Application of Analytical Electron Tomography to the Study of Pathogenic Protozoa*; K Miranda, W Girard-Dias, W de Souza; Universidade Federal do Rio de Janeiro, Brazil; K Miranda, W de Souza; Instituto nacional de Metrologia, Brazil
- 1316 *Understanding Elemental Uptake in Plants Using High Resolution SIMS and Complementary Techniques*; K Moore, C Grovenor; University of Oxford, UK; P Tosi, M Hawkesford, P Shewry, F Zhao; Rothamsted Research, UK
- 1318 *Fast Mapping of Biological Samples With Large Area EDS Detectors*; CL Collins, C McCarthy, N Rowlands, SR Burgess; Oxford Instruments Nanoanalysis, UK
- 1320 *Otolith Biomineralisation: Insights From a Microstructural and Microanalytical Study*; A McFadden, B Gillanders, B Wade, A Pring; The University of Adelaide, Australia; A Pring; The South Australian Museum, Australia
- 1322 *Location of Zinc in Trichomes of the Plant *Picris divaricata**; GR Bauchan, C Murphy, C Pooley; Electron & Confocal Microscopy Unit; CL Broadhurst, RL Chaney; Environmental Management and Byproducts Utilization Lab
- 1324 *Listeria monocytogenes Infects the Zebrafish Central Nervous System; A Useful Model to Analyze the Neuroimmune Response*; CP Corbo, CE Gaylets, AJ Molesan, WA Rivera; Wagner College
- 1326 *Distribution of Calcium and Phosphorus in Leaves of the Proteaceae*; PL Clode, P Hayes, CG Pereira, H Lambers; The University of Western Australia, Australia
- 1328 *Features of Acanthocephalan Hooks Using Dual Beam Preparation and XEDS Phase Maps*; MD Standing, RA Heckmann; Brigham Young University
- 1330 *EDS Mapping of Sub-Surface Plant Materials Using Non-Traditional Operating Conditions*; TL Nylese; EDAX
- 1332 *STEM Characterization of Nano-Crystallites in the Nacre Biomineralization of Mollusk Shells (*Pinna nobilis*)*; R Hovden, SE Wolf, ME Holtz, DA Muller, LA Estroff; Cornell University; SE Wolf; Friedrich-Alexander-University Erlangen-Nürnberg, Germany
- 1334 *Transmission Electron Microscopy of Lipid Vesicles in Liquid Cells*; CM Brown, KL Klein, DV Krogstad, GA Myers, AA Herzing; NIST; KL Klein; University of the District of Columbia

- 1336 *Cheese Matrix Microstructure Studied by Advanced Microscopic Techniques*; Z Burdíkóvá, C Hickey, MAE Auty, JJ Sheehan; Teagasc Food Research Centre, Ireland; J Pala, Z Švindrych; Charles University, Czech Republic; I Steinmetz; Leica Microsystems CMS GmbH, Germany; V Krzyzanek, K Hrubanova; Institute of Scientific Instrument ASCR, Czech Republic; K Hrubanova; Brno University of Technology, Czech Republic
- 1338 *Electron and Helium Ion Imaging of Arabidopsis Affected by Genetic Mutation and Thermochemical Treatment for Biofuel Applications*; AE Curtin, AN Chiaramonti, AW Sanders; National Institute of Standards and Technology; PN Ciesielski, BS Donohoe; Biosciences Center, National Renewable Energy Laboratory; C Chapple, N Mosier; Purdue University
- 1340 *RIMAPS Analysis as a Tool to Elucidate Ascospore Ornamentation Pattern*; SM Romero; Química Orgánica, Argentina; RM Comerio, EA Favret; INTA, Argentina; SM Romero, EA Favret; CONICET Buenos Aires, Argentina

### ***Light Sheet and Multi Photon Imaging***

- 1342 *Using Two-Photon Intravital Imaging to Study Developmental Plasticity of Neural Circuits*; M Munz, D Gobert, V Higenell, MR Van Horn, S Glasgow, A Schohl, ES Ruthazer; McGill University, Canada
- 1344 *Thrombus Formation Processes are dependent on Endothelial Injuries: Examined by In vivo Two-Photon Molecular Imaging and Laser Manipulation*; S Nishimura; The University of Tokyo, Japan; Jichi Medical University, Japan
- 1346 *Artery Cell Contraction via ROS and NO Balance Examined by In Vivo Multi-Photon Imaging Technique and Laser Injuries Technique*; S Nishimura; The University of Tokyo; Jichi Medical University, Japan
- 1348 *Cryo-Imaging of Inflated Frozen Human Lung Sections at -60°C using Multiphoton and Harmonic Generation Microscopy*; T Abraham; Penn State College of Medicine; JC Hogg; University of British Columbia, Canada

### ***Optical, Confocal and Fluorescence Imaging***

- 1350 *Compact Orientation-Independent Differential Interference Contrast (OI-DIC) Microscope Designed for High Resolution and High Sensitivity Mapping of Optical Path and Optical Path Gradient*; M Shribak; Marine Biological Laboratory
- 1352 *Intravital Microfluidic Windows for Delivery of Chemicals, Drugs and Probes*; P Myneni, G Wright, C Janetopoulos; Vanderbilt University; A Terekhov, W Hofmeister; University of Tennessee Space Institute; C Janetopoulos; Vanderbilt University School of Medicine Nashville
- 1354 *Engineered Fluorescent Proteins Bring Biochemistry to Light*; RE Campbell; University of Alberta; Canada
- 1356 *Development of Fluorogenic Antioxidants to Monitor Reactive Oxygen Species in the Lipid Membrane of Live Cells*; K Krumova, LE Greene, R Godin, R Lincoln, G Cosa; McGill University, Canada

- 1358 *Fluorescence Lifetime pH Measurements in Cheese Matrix*; Z Burdík, C Hickey, MAE Auty, JJ Sheehan; Teagasc Food Research Centre, Republic of Ireland; Z Švindrych, J Pala; Charles University, Czech Republic; V Čmiel; University of Technology, Czech Republic
- 1360 *Presentation in Microscopy: Selection of Color to Accommodate Those with Color Vision Deficiency*; DR Keene, SF Tufa; Shriners Hospitals for Children, Oregon
- 1362 *Artifact-Free 3D Reconstruction for Optical Projection Tomography*; J Michálek, M Čapek; Institute of Physiology, Academy of Sciences of the Czech Republic, Czech Republic
- 1364 *Expression of TaV Tagged Sindbis Virus (TR339) in Aedes albopictus Cell Lines and Adult Mosquitoes*; J Saredy, D Bowers; University of North Florida
- 1366 *The Search for MET or a MET Homolog Expressed by Dugesia Dorocephala*; JF Blaize, SJ Browne; Wagner College

### ***Utilizing Microscopy for Research and Diagnosis of Diseases in Humans, Plants, and Animals***

- 1368 *Diagnosing Platelet Function Disorders by Electron Microscopy*; WT Gunning; University of Toledo
- 1370 *Quantifying Changes in Nuclear Organization in Normal vs. Cancer Cells Using X-ray Tomography*; EA Smith, MA Le Gros, CA Larabell; University of California San Francisco; MA Le Gros, CA Larabell; Lawrence Berkeley National Laboratory; M Myllys; University of Jyväskylä
- 1372 *Electron Microscopy in the Analysis of Renal Biopsies: Always the Last Step?*; DN Howell; Duke University and Durham Veterans Affairs Medical Centers
- 1374 *The Diagnostic Utility of Transmission Electron Microscopy in Contemporary Human Medicine: Experience at a University Hospital*; KM Weidenheim, GW Stephney; Montefiore Medical Center and Albert Einstein College of Medicine
- 1376 *Studies of the Interaction of Cardiac Lipid Droplets with Mitochondria Using Electron Microscopy*; J Sotiris, J Strong, R-c Hsia; University of Maryland Baltimore School of Dentistry; C Sztalryd; University of Maryland School of Medicine
- 1378 *Fluorescent and Electron Microscopy Revealed Critical Roles of C2cd3 in Centriolar Distal Appendage Assembly and Cilia Biogenesis*; X Ye, H Zeng, G Ning, A Liu; The Pennsylvania State University
- 1380 *Utilizing Quantitative Phase Microscopy to Observe Cellular Response to Treatment and Dynamic Behaviors*; K Creath, G Goldstein; 4D Technology Corp; K Creath; University of Arizona; Optineering
- 1382 *Architectural Niche Organization by LHX2 is Linked to Hair Follicle Stem Cell Function*; H Amalia Pasolli, AR Folgueras, E Fuchs; The Rockefeller University
- 1384 *Post-Renal Transplant Microsporidiosis*; PE Kysar, S Barnhard, ER Lee, X Liu, R Ramsamooj; University of California, Davis

- 1386 *Halicephalobus Infection in a Fatal Case of Encephalomyelitis*; CS Goldsmith, J Bhatnagar, C Drew, ML Eberhard; Centers for Disease Control and Prevention
- 1388 *The Enigma of the Pericardial Reaction in Rheumatic Heart Disease*; S Siew; Michigan State University
- 1390 *Histomorphometric and Immunohistochemical Analysis in the Uterus of Rats Treated with Genistein or Estrogen Immediately or Later After Castration*; AAF Carbonel, JHRC Girão, LA Reis, CC Maganhin, MJ Simões; Universidade Federal de São Paulo, Brazil; RS Simões, EC Baracat, JM Soares, Jr.; Universidade de São Paulo, Brazil
- 1392 *Pharmacological Preconditioning with Gentamicin (G) Attenuated the Toxicity in LLC-PK1 and Acute Kidney Injury in Rats*; LA Reis, N Schor; UNIFESP/EPM, Brazil; AAF Carbonel, CC Maganhin, MJ Simões; Federal University of São Paulo, UNIFESP –Brazil
- 1394 *Microwave and Vacuum Assisted Fixation and Cytochemical Localization for Lungs of Chicken, Gallus domesticus*; E Ann Ellis; Biological Electron Microscopist
- 1396 *Photosynthetic Algae-Insulinoma Cell Fusion Creating Self-Sustaining Insulin Producer*; D Heller, R Pergolizzi, A Calabro, C Queenan; Bergen County Academies
- 1398 *Melatonin Can Affect the CYP19 Immunoexpression of Female Rat ovary*; CC Maganhin; Universidade Federal de São Paulo, Brazil; RS Simões; LFP Fuchs, EC Baracat, JM Soares, Jr.; University of São Paulo, Brazil; GRS Sasso, AAF Carbonel, ML Calió ML, LA Reis, MJ Simões; Universidade Federal de São Paulo, Brazil
- 1400 *3D Visualization of Motor-Neurons in Mice Spinal Cord Using FIB/SEM Tomography*; B Deng, REA Williams, D Huber, J Sosa, DW McComb, CM Freria, PG Popovich; The Ohio State University
- 1402 *Effect of Melatonin on Ovarian Function by Over-expression and Down-regulation of Genes Related to Steroidogenesis in Pinealectomized Rats*; CC Maganhin, JHRC Girão, GRS Sasso, AAF Carbonel, LA Reis; Universidade Federal de São Paulo, Brazil; RS Simões, LFP Fuchs, EC Baracat, JM Soares, Jr.; University of São Paulo, Brazil

### ***Microscopy, Microanalysis and Image Analysis in the Pharmaceutical Sciences***

- 1404 *Chewing the Fat: Is Autophagy a Potential Therapeutic Target for Atherosclerosis and Other Diseases of Sterol Metabolism?*; W. Gray (Jay) Jerome, C Netherland-Van Dyke, C Romer; Vanderbilt University
- 1406 *CryoEM Based Models for Adenovirus Neutralization by Human Alpha-Defensin 5*; N Gulati, PL Stewart; Case Western Reserve University; JG Smith; University of Washington; GR Nemerow; The Scripps Research Institute
- 1408 *Transmission Electron Microscopy Used to Diagnose Acute Toxoplasmosis in a Quarantined, Captive Born Cynomolgus Macaque*; J Megill, J MacGuire, EB Janovitz, RK Jackson; Bristol-Myers Squibb; JP Dubey; Animal research service
- 1410 *Validation of a Digital Pathology Whole Slide Imaging System*; BE Maleeff; GlaxoSmithKline

- 1412 *From Discovery to Finished Products: Innovative Applications of Surface Mass Spectrometry in Pharmaceutical Industry*; N Talaty, HH Gong, S Koeniger, A Vogt, M Pheil, P Fruehan, J Neilly, M Lopour, RW Johnson; AbbVie
- 1414 *Characterization of Lubricant Distribution of Die Wall Lubricated Tablets by Scanning Electron Microscopy and Energy Dispersive X-ray Spectroscopy*; J Neilly, A Delke, R Slade; AbbVie; HH Hou; Allergan, Inc.
- 1416 *Patent Litigation and the Power of Correlative Microscopy*; SL Goodman; Microscopy Innovations LLC; JJ Edwards; Knobbe, Martens, Olson & Bear LLP
- 1418 *Proper Sample Preparation for Characterization of Drug Delivery Carriers in TEM*; H Qian; National Institute for Nanotechnology, Canada
- 1420 *Investigation and Analysis of Medical Device Contamination; Practical Applications of Light and Electron Microscopy*; RS Brown; MVA Scientific Consultants, Inc
- 1422 *Multi-parametric Analysis of Intrinsic Cell Death Using Live Cell Microscopy*; GN Joshi, DA Knecht; University of Connecticut
- 1424 *Evaluation of estrogenic pathway genes in the vagina of rats treated with genistein or estrogen immediately or later after castration*; AAF Carbonel, MA Santos, CC Maganhin, MJ Simões; Federal University of São Paulo, Brazil; RS Simões, EC Baracat, JM Soares, Jr.; University of São Paulo, Brazil; LA Reis; Federal University of São Paulo, Brazil; CRA Bertoncini; Federal University of São Paulo, Brazil
- 1426 *Effects of Exosomes (EXOs) Derived by Renal Pluripotent Stem Cells (rPSCs) on the Cisplatin (Cis) Nephrotoxicity in Mice*; LA Reis, N Schor, AAF Carbonel, CC Maganhin, M de J Simones; UNIFESP/EPM, Brazil

## ***Biological Sciences - General***

- 1428 *Observations On The Ultrastructure Of The Naked Freshwater Flagellate Chrysochromulina tobin sp. nov. (Haptophyta)*; SB Barlow; San Diego State University; RA Cattolico; University of Washington
- 1430 *Synchrotron Chemical and Structural Analysis of Tyrannosaurus rex Blood Vessels: The Contribution of Collagen Hypercrosslinking to Tissue Longevity*; EM Boatman, R Gronsky; University of California, Berkeley; MB Goodwin; University of California Museum of Paleontology; H-Y Holman, S Fakra; Lawrence Berkeley National Laboratory; MH Schweitzer; North Carolina State University; JR Horner; Museum of the Rockies
- 1432 *A Novel Method to Manipulate Osteoblastic Differentiation*; D Batarseh, D Leonardi, A Calabro, C Queenan; Bergen County Academies
- 1434 *Cell Ultrastructure and Distribution of Trifluoroacetylated Protein-Adducts in Early Hepatic Injury in Mice Induced by Inhalation Anesthetic, Halothane.*; CA Brantner, MP Daniels, M Bourdi, M Chakraborty, LR Pohl; National Institutes of Health

- 1436 *A study of Unidirectionally Aligned Collagen-Silk Composite Fibers and the Application in hdpPSC Neural Differentiation*; B Zhu, W Li, C Segre, R Janota, N Chi, R Wang; Illinois Institute of Technology; R Lewis; Utah State University
- 1438 *Automated Cell Counting in a High Density, Polymer-Coated, Live Single Cell Sandwich Microarray*; JR Yaron, J Pan, KB Lee, K-C Wang, CL Anderson, HL Glenn, DR Meldrum, T Borkar; Arizona State University

### ***Specimen Preparation for Biological Sciences***

- 1440 *Testing the Validity of “Old Wives Tales” About Fixation of Tissue Cultured Cells*; PS Connelly; National Institutes of Health
- 1442 *Cryo-Planing of Small Biological Specimens for SEM Using mPrep Capsules*; WC Plumley; Madison College

### ***Analytical Techniques and Their Application for the Study of Deformed Microstructures***

- 1444 *Changing the Paradigm for Engineering Design by Merging High Energy X-ray Data with Materials Modeling*; PA Shade, JC Schuren, TJ Turner, DM Dimiduk; Air Force Research Laboratory; JV Bernier, SF Li; Lawrence Livermore National Laboratory; B Blank; PulseRay; J Lind, RM Suter; Carnegie Mellon University; P Kenesei, J Almer; Argonne National Laboratory; U Lienert; DESY-Petra III, Germany
- 1446 *Precession Electron Diffraction Based TEM Studies of Microstructure Evolution in Severely Plastically Deformed Austenitic Stainless Steel*; Y Idell, JMK Wiezorek; University of Pittsburgh
- 1448 *A Quantitative Assessment of Microtexture in Titanium Alloys using Destructive and Nondestructive Methods*; AL Pilchak, M Groeber; Air Force Research Laboratory; J Li, G Sha, S Rokhlin; The Ohio State University; J Tucker; UES, Inc.
- 1450 *Probing the Structure and Mechanical Properties of Individual MgAl<sub>2</sub>O<sub>4</sub> Porous Agglomerates and Their Effects on Densification*; JF Rufner, RHR Castro, K van Benthem; University of California; TB Holland; Colorado State University
- 1452 *Electron Channeling Contrast Observations in Deformed Magnesium Alloys*; S Kaboli, H Demers, N Brodusch, R Gauvin; McGill University
- 1454 *Application of Precession Electron Diffraction in Deformation Studies of Advanced Non-Ferrous Structural Alloys*; I Ghamarian, Y Liu, PC Collins; University of North Texas
- 1456 *Analyzing Dislocations with Virtual Dark Field Images Reconstructed from Electron Diffraction Patterns*; EF Rauch, M Véron; CNRS-Grenoble INP, France
- 1458 *Magnetic Domain Structure and Crystal Orientation Revealed by a Forescatter Detector and Electron Backscatter Diffraction*; M Gallagher, N Brodusch, R Gauvin, RR Chromik; McGill University

- 1460 *Strength and Plasticity of H- and Oxide- Terminated Cubic Si Nanocrystals*; AJ Wagner, E Hintsala, U Kortshagen, W Gerberich, KA Mkhoyan; University of Minnesota
- 1462 *Combined Use of DIC, EBSD and Simulation to Understand the Microscale Plastic Strain Distribution in Mg Alloys*; CW Sinclair; The University of British Columbia, Canada; G Martin; Domaine Universitaire, France; RA Lebensohn; Los Alamos National Laboratory
- 1464 *Comparison of Techniques for Strain Measurements in CuInSe<sub>2</sub> Absorber Layers of Thin-Film Solar Cells*; N Schäfer, M Klaus, C Genzel, J Marquart, S Schorr, T Rissom, D Abou-Ras; Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany; J Marquart, S Schorr; Freie Universitaet Berlin, Institute of Geological Sciences, Germany; A J Wilkinson; University of Oxford, U.K.; T Schulli; European Synchrotron Radiation Facility, France; T Schmid; Federal Institute for Materials Research and Testing
- 1466 *Structure-Property Investigations via SEM In-Situ Micromechanical Testing*; R Wheeler; MicroTesting Solutions LLC; D Bhattacharya; Australian Nuclear Science and Technology Organization, Australia; A Pandey, A Shyam; Oak Ridge National Laboratory; A Pandey; LG Fuel Cell Systems Inc.; A Shiveley; Shiveley Technology Corp.; D Sergison; Sergison Machine
- 1468 *Interdependencies Between Mechanical Properties and Microstructural Development During One-Dimensional Shock Loading*; JCF Millett; AWE, Aldermaston, United Kingdom
- 1470 *EBSD-Analysis of Microstructural Changes Below Wire-EDMed Surfaces*; A Schwedt, L Hensgen, J Dieckmann, A Klink, F Klocke, J Mayer; RWTH Aachen University, Germany
- 1472 *Experimental Investigation of Sub-Surface Deformation Using EBSD in Single Crystal Aluminum During Orthogonal Micromachining*; S Nahata, OB Ozdoganlar, YN Picard; Carnegie Mellon University; N Kota; Science Applications International Corporation
- 1474 *Experimental Measurement of Young's Modulus from a Single Crystalline Cementite*; B-W Koo, Y-J Chang, S Pyo Hong, CS Kang, KH Oh, Y-W Kim; Seoul National University, Republic of Korea; SW Jeong, W-J Nam; Kookmin University, Republic of Korea; I-J Park, Y-K Lee, Yonsei University, Republic of Korea
- 1476 *Transmission Electron Diffraction Investigation of White Etching Areas in Bearing Steels: A Comparison Between TKD and TEM*; D Wu, V Bedekar, S Hyde; Timken Technology Center; A Avishai, A Heuer; Case Western Reserve University
- 1478 *Effect of Solubilization Temperature, Zn Addition and Thermo-Mechanical Treatments in the Microstructure of the Aluminum 2024 Alloy*; CG Garay-Reyes, L González-Rodelas, I Estrada-Guel, R Martínez-Sánchez; Centro de Investigación en Materiales Avanzados (CIMAV), México
- 1480 *Ultrashort Pulsed Laser Induced Heat Affected Zones Characterized by Ion Channeling Contrast Imaging*; H Thompson, J Lammatao, MD Hecht, A Yousif, YN Picard; Carnegie Mellon University; BR Campbell; Robert Morris University
- 1482 *New Tools for the Study of Deformed and Heat-Treated Materials via Electron Backscatter Diffraction*; TM Rampton, MM Nowell, SI Wright; EDAX, A Division of Ametek



- 1484 *Extraction of Metastable Icosahedral Quasicrystalline Nanoparticles from Zirconium and Hafnium Based Metallic Glasses*; M Bauer, M Caputo, C Li; Clarion University; D Li; Youngstown State University; L Wang; Changchun Institute of Applied Chemistry, China
- 1486 *JECP/QSAED, a Computer Program for Quantification of SAED Patterns*; XZ Li; University of Nebraska
- 1488 *Effects of Preheat Supply on Embossed Pattern Depth in Roll-to-Roll Process*; S Kim, Y Son, H Park, C Park, D Yun; Korea Institute of Machinery & Materials, South Korea
- 1490 *Rayleigh Instability-Driven Fragmentation of Ion Tracks*; AS Khalil; Tabbin Institute for Metallurgical Studies, Egypt
- 1492 *Charge Density Determination for Al-Rich Composition L1<sub>0</sub>-Ordered gamma-TiAl by Convergent Beam Electron Diffraction*; X Sang, AK Kulovits, G Wang, JMK Wiezorek; University of Pittsburgh; X Sang; North Carolina State University; AK Kulovits; Carnegie Mellon University
- 1494 *NbC Precipitation and Deformation of SS 347H Crept at 850°C*; BS Amirkhiz, S Xu; CanmetMATERIALS, Canada
- 1496 *Formation Process of 8° [001] Symmetric Tilt and 65.5° [-110] Symmetric Tilt Grain Boundaries During Annealing of a Cross Rolled Aluminium Sample*; M Shamsuzzoha; University of Alabama
- 1498 *Synthesis and Characterization of Al Reinforced with Al<sub>4</sub>C<sub>3</sub> Nanoparticles Produced by Mechanical Milling*; A Santos-Beltrán, V Gallegos-Orozco; Universidad Tecnológica Junta de los Ríos, México; M Santos-Beltrán, R Goytia-Reyes, R Martínez-Sánchez; Centro de Investigación en Materiales Avanzados, México
- 1500 *Mechanical and Tribological Properties of Nanoparticles Aggregates Determined using in situ AFM in the TEM*; A Molza, J-L Mansot; Groupe de Technologie des Surfaces et Interfaces; J-L Mansot; Université des Antilles et de la Guyane, France; MJ-F Guinel; University of Puerto Rico; L Legras; EDF - R&D, France

## ***Advances in In-situ Microscopy***

- 1502 *Nanoscale Dynamics in Ultrathin Liquids Visualized with TEM*; J Lu, Z Aabdin, U Mirsaidov; National University of Singapore, Singapore
- 1504 *In-Situ Liquid Cell Electron Microscopy of the Solution Growth of Core-Shell Nanostructures*; E Sutter, K Jungjohann, S Bliznakov, EA Stach, P Sutter, S Wong; Brookhaven National Laboratory; A Courty; Université Pierre et Marie Curie, France
- 1506 *Tuning Electrodeposition Parameters for Tailored Nanoparticle Size, Shape, and Morphology: An In Situ ec-STEM Investigation*; RR Unocic, RL Sacci, GM Veith, NJ Dudney, KL More; Oak Ridge National Laboratory
- 1508 *Imaging Shape-Dependent Corrosion Behavior of Pt Nanoparticles over Extended Time Using a Liquid Flow Cell and TEM*; J Wu, W Gao, H Yang, J-M Zuo; University of Illinois

- 1510 *Correlative Fluorescence and Liquid Cell STEM of Live Magnetotactic Bacteria*; T Woehl, S Kashap, T Prozorov; Ames DOE Laboratory; M Sanchez-Quesada, CJ Lopez; University of Granada, Spain; T Perez-Gonzalez, D Faivre; Max Plank Institute for Colloids and Interfaces, Germany; D Trubytyn, D Bazylinski; University of Nevada, Las Vegas
- 1512 *Atomic Level In-Situ Characterization of NiO-TiO<sub>2</sub> Photocatalysts under Light Irradiation in Water Vapor*; L Zhang, PA Crozier; Arizona State University
- 1514 *Novel Hybrid Sample Preparation Method for In Situ Liquid Cell TEM Analysis*; X Zhong, MG Burke, S Schilling, SJ Haigh, NJ Zaluzec; University of Manchester, UK; MA Kulzick; BP Research Centre; NJ Zaluzec; Argonne National Laboratory
- 1516 *Radiolysis during Liquid Cell Electron Microscopy*; NM Schneider, MM Norton, BJ Mendel, JM Grogan, HH Bau; University of Pennsylvania; JM Grogan; Hummingbird Scientific; FM Ross; IBM T. J. Watson Research Center
- 1518 *X-ray and Electron Energy Loss Spectroscopy in Liquids in the Analytical S/TEM*; NJ Zaluzec, A Demortiere, RE Cook, RE Koritala, JG Wen, DJ Miller; Argonne National Laboratory; MA Kulzick; BP Corporate Research Center
- 1520 *High Resolution In-situ Study of Reactions in Graphene Liquid Cells*; C Wang, Q Qiao, RF Klie, T Shokuhfar; University of Illinois; T Shokuhfar; Michigan Technological University
- 1522 *In-Situ Synthesis of New Electrode Materials for Li-Ions Batteries using a Cold FEG Environmental HRTEM*; ML Trudeau, R Veillette, K Zaghib; Hydro-Québec Research Institute, Canada; JY Howe; Hitachi High-Technologies Canada, Canada
- 1524 *Nanoscale Imaging of Lithium Ion Distribution During In Situ Operation of a Battery Electrode and Electrolyte*; ME Holtz, Y Yu, D Gunceler, J Gao, R Sundararaman, KA Schwarz, TA Arias, HD Abruna, DA Muller; Cornell University
- 1526 *Operando Transmission X-ray Microscopy Studies on Li-Ion Batteries*; JN Weker, JC Andrews, MF Toney; SLAC National Accelerator Laboratory; Y Cui, W Chueh; Stanford University
- 1528 *In Situ Transmission Electron Microscopy of the Electrochemical Intercalation of Graphite in Concentrated Sulfuric Acid*; BC Regan, ER White, J Lodico, G Carlson, N Macro, WA Hubbard; University of California
- 1530 *Visualization of Active and Passive Control of Morphology during Electrodeposition*; NM Schneider, JM Grogan, Haim H. Bau; University of Pennsylvania; JH Park, S Kodambaka; University of California; JM Grogan; Hummingbird Scientific; DA Steingart; Princeton University; FM Ross; IBM T. J. Watson Research Center
- 1532 *In situ Methods for Analysis of Polymer Electrolyte Membrane Fuel Cell Materials by Soft X-ray Scanning Transmission X-ray Microscopy*; AP Hitchcock, V Lee; McMaster University, Canada; V Berejnov, D Susac, J Stumper; Automotive Fuel Cell Cooperation, Canada

- 1534 *In-situ Transmission Electron Microscopy (TEM) Study on the Lithium Ion Transport in Si-Ge Heterostructured Nanowires*; Y Liu, XH Liu; Sandia National Laboratories, Albuquerque; B-M Nguyen, J Yoo, ST Picraux, SA Dayeh; Los Alamos National Laboratory; B-M Nguyen, SA Dayeh; University of California San Diego; JP Sullivan; Sandia National Laboratories
- 1536 *In-situ TEM Study of Internal and External Stress on Lithiation Behavior of High Capacity Anode Materials with a Large Volume Change*; C-M Wang, M Gu, DE Perea; Pacific Northwest National Laboratory; H Yang, S Zhang; Pennsylvania State University
- 1538 *In Operando Transmission Electron Microscopy Imaging of SEI Formation and Structure in Li-Ion and Li-Metal Batteries*; RL Sacci, NJ Dudney, KL More, RR Unocic; Oak Ridge National Laboratory
- 1540 *Corrosion of Metal Films Observed Using In Situ and Ex Situ Electron Microscopy*; SW Chee, D Duquette, R Hull; Rensselaer Polytechnic Institute; FM Ross; IBM TJ Watson Research Center
- 1542 *Nanoscale Wear as a Stress-Assisted Chemical Reaction: An in-situ TEM Study*; RW Carpick, TDB Jacobs; University of Pennsylvania
- 1544 *High Plastic Strain of Silica Microparticles under Electron Beam Irradiation*; D Stauffer, S Bhowmick, R Major, OL Warren, SAS Asif; Hysitron, Inc, Minneapolis
- 1546 *Mechanical and Electrical Control of Charged Domain Walls in Ferroelectric Materials*; L Li, JR Jokisaari, XQ Pan; University of Michigan, Ann Arbor; A Melville, C Adamo, DG Schlom; Cornell University, Ithaca
- 1548 *In Situ Biasing TEM Characterization of Resistive Switching Phenomena in TiO<sub>2</sub>-Based RRAM*; J Kwon, AA Sharma, JA Bain, YN Picard, M Skowronski; Carnegie Mellon University, Pittsburgh
- 1550 *In Situ STEM of Ag and Cu Conducting Bridge Formation through Al<sub>2</sub>O<sub>3</sub> in Nanoscale Resistive Memory Devices*; WA Hubbard, ER White, A Kerelsky, JJ Lodico, BC Regan; University of California, Los Angeles
- 1552 *Fast Imaging of Carbon Nanotube Nucleation and Growth Processes using Environmental TEM*; DN Zakharov, EA Stach, S Misawa; Brookhaven National Laboratory, Upton; M Bewedy, AJ Hart; Massachusetts Institute of Technology, Cambridge; C Czarnik; Gatan, Inc, Pleasanton
- 1554 *In Situ Investigation of the Carbothermal Reduction of ZnO Nanowires*; J Liu; Arizona State University, Tempe; LF Allard; Oak Ridge National Laboratory
- 1556 *Phase Transitions, Domains Walls and Defects Dynamics of LaAlO<sub>3</sub> via In Situ Heating in the Transmission Electron Microscope*; Q Mao, M Holtz, DG Schlom, DA Muller; Cornell University, Ithaca
- 1558 *In-Situ TEM Investigation of Reduction-Oxidation Reactions During Densification of Iron Oxide Nanoparticles*; CS Bonifacio, GK Das, IM Kennedy, K van Benthem; University of California, Davis
- 1560 *Live Imaging of Reversible Domain Evolution in BaTiO<sub>3</sub> on the Nanometer Scale Using In-Situ STEM and TEM*; A Schilling, M Arredondo, JF Einsle, M Gregg; Queen's University Belfast, UK; B Barton, JR Jinschek, L Mele, P Dona, J Ringnalda; FEI Company, The Netherlands

- 1562 *The Design and Implementation of a Single, Double, and Triple Concurrent Beam In Situ Ion Irradiation TEM Facility*; D Bufford, K Hattar; Sandia National Laboratories, Albuquerque
- 1564 *Operando TEM of Ru/RuO<sub>2</sub> Catalyst Performing CO Oxidation*; BK Miller, PA Crozier; Arizona State University, Tempe
- 1566 *Electron Microscopy Studies of Structure and Dynamics in MoS<sub>2</sub>-Based Hydrodesulfurization Catalysts*; LP Hansen, M Brorson, S Helveg; Haldor Topsoe A/S, Denmark; E Johnson; Niels Bohr Institute, Denmark; QM Ramasse; SuperSTEM Laboratory; C Kisielowski; Lawrence Berkeley National Laboratory, Berkeley
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- 1616 *Environmental Electron Microscopy: Electron Beam Effects in Electrochemistry*; Y Liu, S Dillon; University of Illinois, Urbana–Champaign
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- 1640 *Fabrication and Healing of Faceted Nanopores in Magnesium*; S Wu, H Sheng, C Liu, F Cao, Y Liu, H Zheng, D Zhao, J Wang; Wuhan University, China
- 1642 *Utilization of an ESEM™ with an Embedded Heating Stage to Investigate Pyrolysis in Immature Oil Shale*; M Castagna, E Goergen, K Skinner; FEI Company, Oregon; JE Dahl; Stanford University
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## *Mineral Analyses from Laboratory to Spacecraft*

- 1666 *Remote-Sensing of Planetary Surface Using Infrared Spectroscopy*; J Helbert; Institute for Planetary Research, Germany
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- 1690 *A Synthesis of Instrumental Analytical Techniques for Examination of the Thermal History of Pallasite Meteorites*; KL Crispin, S Mikhail, A Shahar, V Hillgren, N Bennett; Carnegie Institution of Washington; S Mikhail; The University of Edinburgh, UK; N Fowler-Gerace; University of Toronto, Canada; R Ash, WF McDonough; University of Maryland
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- 1710 *Origin of Asymmetric Symplectitic Texture in Mantle Xenoliths from the Fangshan Basalt, Eastern China*; D Zhao; University of Texas at Austin
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- 1720 *Correlated Petrographic Analysis*; JA Reffner; CUNY
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### ***Carbon Nanomaterials and Related Counterparts: Recent Results and Challenges***

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- 1734 *Electronic Structure Modification of Boron and Nitrogen Ion-Implanted Graphene Fingerprinted by STEM-EELS*; DM Kepaptsoglou, QM Ramasse; SuperSTEM Laboratory, United Kingdom; CR Seabourne, T Hardcastle, AJ Scott; University of Leeds, United Kingdom; R Nicholls; University of Oxford, United Kingdom; W Pierce, R Zan, U Bangert; University of Manchester, United Kingdom; U Bangert; University of Limerick, Ireland
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- 1742 *In-situ TEM Observation of Pt-terminating Carbyne on Graphene*; E Kano; University of Tsukuba, Japan; A Hashimoto, M Takeguchi; National Institute for Materials Science, Japan
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- 1748 *Optical Spectroscopy Integrated with Environmental Scanning Transmission Electron Microscope: A Comprehensive In Situ Characterization Platform*; M Picher; National Institute of Standards and Technology; University of Maryland; S Mazzucco, S Blankenship, G Holland, R Sharma; National Institute of Standards and Technology

- 1750 *Doping Properties and Phase Transition in Single-Layer MoS<sub>2</sub>*; Y-C Lin, N Yoshiko, K Suenaga; National Institute of Advanced Industrial Science and Technology, Japan; DO Dumcenco, Y-S Huang; National Taiwan University of Science and Technology, Taiwan; H-P Komsa, AV Krasheninnikov; University of Helsinki, Finland
- 1752 *Structure and Optical Properties of Some Layered Two-Dimensional Transition-Metal Dichalcogenides: Molybdenum Disulfide, Molybdenum Diselenide, and Tungsten Diselenide*; ES Reifler, NT Nuhfer, E Towe; Carnegie Mellon University
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- 1766 *Atomic Resolution Study of Defects in Graphene*; JH Warner; University of Oxford, United Kingdom
- 1768 *Deadtime Correction and Hydride Evaluation for Atom-Probe Data, with Applications for Studies of Nanoscale Grains and Carbon*; JB Lewis, C Floss, TL Daulton; Washington University; D Isheim, DN Seidman; Northwestern University
- 1770 *In Situ High Temperature Atomic Resolution Transmission Electron Microscopy of 2D Nanomaterials*; AL Gibb, A Zettl; University of California Berkeley; N Alem; The Pennsylvania State University; J-H Chen; Peking University, China; J Ciston; Lawrence Berkeley National Lab

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- 1778 *Asymmetric Decoration of Crystalline Graphene with Pt@TiO<sub>2</sub> Nanocrystals as High-Efficient Photocatalyst*; W Qian, S Flower, L Keel, J Jiao; Portland State University
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- 2036 *SEM and ToF-SIMS Ion Imaging Applied to Characterization of Fungal Biodeterioration of Paper in the Context of Cultural Heritage Collections*; HM Szczepanowska, YS Goreva; Smithsonian Institution

- 2038 *Investigating the Firing Protocol of Athenian Pottery Production: A Raman and Hi-Resolution TEM Study*; B Foran; The Aerospace Corporation; I Cianchetta, K Trentelman; Getty Conservation Institute; M Walton; Northwestern University; A Mehta; Stanford Synchrotron Radiation Lightsource, Stanford University
- 2040 *Soft X-ray Absorption Spectroscopy and Imaging of Sulfur in Lapis Lazuli*; MS Walton; Northwestern University/Art Institute of Chicago Center for Scientific Studies in the Arts; AA Gambardella, CMS Patterson; Getty Conservation Institute
- 2042 *Investigation into Achaemenid Persian Painted Plasters and Glazed Bricks from Persepolis and Pasargadae in the Smithsonian's Freer Gallery of Art*; E Aloiz, J Douglas, A Nagel; Smithsonian Institution
- 2044 *Manganese in Black Crusts on Seneca Sandstone*; CA Grissom, EP Vicenzi, E Aloiz, N Little; Smithsonian Institution; RA Livingston, W Freedman; University of Maryland; J Giaccai; Smithsonian Institution

## ***Surface & Subsurface Microscopy & Microanalysis in Materials & Biological Systems***

- 2046 *Simplified, High-Throughput TOF-SIMS Analysis via HR<sup>2</sup> and Uniform Molecular Imaging of Rough Surfaces*; GL Fisher; Physical Electronics
- 2048 *Probing Liquid Surfaces and Interfaces Using Time-of-Flight Secondary Ion Mass Spectrometry*; X-Y Yu, Z Zhu, B Liu, M Marshall, X Hua, Z Wang, L Yang, A Tucker, W Chrisler, E Hill, T Thevuthasan, J Cowin; Pacific Northwest National Laboratory; E Rodek; SPI Supplies/Structure Probe; Yuehe Lin; Washington State University
- 2050 *Multivariate Analysis Applications in ToF-SIMS*; RM Moision, JA Chaney; The Aerospace Corporation
- 2052 *Nanoscale Surface and Sub-Surface Chemical Analysis of SiGe Nanowires*; W Hourani, E Martinez, JM Fabbri; CEA, LETI, MINATEC Campus, France; P Periwal, F Bassani, T Baron; CNRS, LTM, France; G Patriarche; Laboratoire de Photonique et de Nanostructures-CNRS, France
- 2054 *AES and Related Techniques for Yield Improvement, Metrology and Development Support of ULSI Circuits Manufactured in  $\leq 28\text{nm}$  CMOS Technology*; K Dittmar, S Ohsiek, C Klein, M Weisheit, E Erben, R Binder, K Hempel, H-J Engelmann, J Metzger, M Lenski, D Triyoso; Globalfoundries LLC, Germany
- 2056 *Nanoscale Organic Defect Characterization with AFM-IR*; C Marcott; Light Light Solutions; M Lo, Q Hu, K Kjoller, CB Prater; Anasys Instruments
- 2058 *Multiplexed Biomimetic Lipid Membranes on Graphene by Dip-Pen Nanolithography*; M Hirtz; Karlsruhe Institute of Technology (KIT), Germany; A Oikonomou; The University of Manchester; S Varey, A Vijayaraghavan, The University of Manchester; H Fuchs; University of Münster, Germany
- 2060 *Complimentary XPS and AES Analysis of MoS<sub>3</sub> Solid Lubricant Coatings*; SS Alnabulsi, DF Paul, JF Moulder, JS Hammond; Physical Electronics; JR Lince; The Aerospace Corporation

- 2062 *Chemical Characterization of Material Surfaces Using X-ray Photoelectron Spectroscopy (XPS): The Perfect Complement to Electron Microscopy Techniques*; BR Strohmeier; Thermo Fisher Scientific; RG White, TS Nunney, P Mack, AE Wright; Thermo Fisher Scientific, UK
- 2064 *SEM, TEM, and AFM Analyses of Phase-Separated Polymer Blend Membranes for Gas Separations*; IH Musselman, NP Panapitiya, DK Bushdiecker, II, MP Tomasek, CK Miller, KJ Balkus, Jr., JP Ferraris; The University of Texas at Dallas; CJ Gilpin; Purdue University
- 2066 *Integrating 3D Surface Imaging with FIB/SEM Microscopy*; B Volbert, G Renka, K Schock, S Kleindiek; Kleindiek Nanotechnik, Germany; A Lieb; Nanosurf AG, Switzerland; M Dadras; Centre Suisse d'Électronique et de Microtechnique, Switzerland
- 2068 *Applications of Atomic Force Microscopy in Industrial Polymer Systems*; L Yang, O Guise; SABIC Innovative Plastics, The Netherlands
- 2070 *The Impact of Estrogen Depletion and Drug Treatment on Type I Collagen Microstructure*; M Cauble, E Rothman, K Welch, M Fang, BG Orr, MM Banaszak Holl; University of Michigan; LT Duong, BL Pennypacker; Merck
- 2072 *Nanoscale Calorimetry Reveals Higher Stability of Cholesterol Induced Nanoscale Domains in Lipid Bilayers*; GE Fantner, BW Erickson; École Polytechnique Federal de Lausanne, Switzerland
- 2074 *Time-Resolved Nanometer Scale AFM Imaging of Antimicrobial Peptide Activity on Live Escherichia coli Cells*; A Slade, SC Minne; Bruker Nano Inc.
- 2076 *Mechanics of Biological Cells Studied with Atomic Force Microscopy*; I Sokolov, M Dokukin; Tufts University
- 2078 *Multimodal Chemical and Physical Surface Characterization on a Combined AFM-MS Platform*; OS Ovchinnikova, GJ Van Berkel; Oak Ridge National Laboratory
- 2080 *Molecular Imaging of Self-Assembled Rosette Nanotubes by Scanning Tunneling Microscopy*; J-Y Cho; National Institute for Nanotechnology, National Research Council (NINT-NRC), Canada; L Shuai, M El-Bakkari; University of Alberta, Canada; H Fenniri; Northeastern University
- 2082 *State of the Art Microanalysis Using Raman Microscopy*; P Wang; Bruker Optics Inc.
- 2084 *Characterization of Individual Nanoparticles with Nanoprojectile-SIMS*; AB Clubb, CK Liang, SV Verkhoturov, EA Schweikert; Texas A&M University
- 2086 *In-Situ TOF-SIMS and SFM Measurements Providing True 3D Chemical Characterization of Inorganic and Organic Nanostructures*; E Niehuis, R Moellers, F Kollmer, H Arlinghaus; ION-TOF Technologies GmbH, Germany; L Bernard, HJ Hug, S Vranjkovic; EMPA, Switzerland; R Dianoux, A Scheidemann; Nanoscan AG, Switzerland
- 2088 *Improving Data Quality in Atom Probe Tomography*; DJ Larson, TJ Prosa, DF Lawrence, SN Strennen, E Oltman, IY Martin, DA Reinhard, AD Giddings, DP Olson, JH Bunton, RM Ulfig, TF Kelly; CAMECA Instruments Inc.; JR Goodwin, RL Martens; University of Alabama



- 2090 *Revealing the Dopant Incorporation Mechanisms into Vapor-Liquid-Solid Grown NWs Employing Nano-Probe Scanning Auger Microscopy*; U Givan, S Christiansen; Institute for Nano-Architectures for Energy Conversion, Germany; U Givan, LJ Lauhon; Northwestern University; DF Paul, JS Hammond; Physical Electronics Inc.; Y Rosenwaks; Tel-Aviv University, Israel
- 2092 *Thermo-Oxidative Stability of SiO<sub>x</sub>-doped Diamondlike Carbon Studied via Environmental XPS and AFM*; RW Carpick, F Mangolini, J Hilbert, J Lukes; University of Pennsylvania
- 2094 *The Use of Argon Cluster Ion Sources in Etching of Inorganic Materials with Reduced Chemical Damage: Toward a Better Understanding of Interface Chemistry*; C Moffitt, D Surman; Kratos Analytical, Inc.; J Counsell; Kratos Analytical, Ltd., UK
- 2096 *Nano-Focused Vibrational Spectroscopy Reaching the Single Quantum Level: Imaging Structure, Function, and Dynamics on the Nanoscale*; MB Raschke; University of Colorado
- 2098 *The Practical Aspects of ToF-SIMS Analysis in the Industrial and Contract Laboratory Setting*; B Hagenhoff, E Tallarek, M Fartmann, R Kersting; Tascon GmbH, Germany
- 2100 *Applications of Low Voltage Field Emission Scanning Electron microscopy (FE-SEM) for characterization of Polyethersulfone/ Polyvinylpyrillidone (PES/PVP) Based Materials for Membrane Separations*; P Bajaj, A Berzini, R Giessert, C Strom; SABIC Innovative Plastics, Selkirk, NY
- 2102 *Colossal Carbon Supersaturation of Delta Ferrite in 17-7 PH Stainless Steel*; D Wang, C-W Chen, R Sharghi-Moshtaghin, H Kahn, GM Michal, F Ernst, AH Heuer; Case Western Reserve University, Cleveland
- 2104 *Sliding-induced Microstructure of Cold-Sprayed Copper Coating Observed by Electron Channeling Contrast Imaging*; Y Zhang, N Brodusch, JM Shockley, R Gauvin, RR Chromik; McGill University, Canada
- 2106 *Nanohardness and Microstructure of NiCoAlFeCu and NiCoAlFeCuCr Alloys Produced by Mechanical Alloying*; CD Gómez-Esparza, K Campos-Venegas, O Solis-Canto, JM Herrera-Ramírez, R Martínez-Sánchez; Centro de Investigación en Materiales Avanzados, Mexico; JM Alvarado-Orozco, J Muñoz-Saldaña; Centro de Investigación y de Estudios Avanzados del IPN, Mexico
- 2108 *Investigations on the Microstructure and Microanalysis of the Gas Shale Sample Prepared by SEM Ion Mill by Off-Centering the Ion Beams*; A Asthana; Michigan Technological University, Houghton; A Asthana, RR Cerchiara, LM Marsh, PE Fischione; EA Fischione Instruments, Inc, Export
- 2110 *Osseointegration of Titanium Ti-6Al-4V Alloy Implants in the Rat Femur: A Time-Course SEM Study*; G Sovak; Canadian Memorial Chiropractic College, Canada; A Weiss, I Gotman; Technion – Israel Institute of Technology, Israel
- 2112 *Elemental Quantification and Visualization of GaN Structures using APT and SIMS*; AD Giddings, TJ Prosa, HG Francois-Saint-Cyr, DJ Larson; CAMECA Instruments Inc, Madison; A Merkulov; CAMECA SAS, France; FA Stevie; North Carolina State University; NG Young, JS Speck; University of California, Santa Barbara

- 2114 *Structural and Morphological Investigations of  $\beta$ -Cyclodextrin-Coated Silver Nanoparticles*; PF Andrade, AF de Faria, DS da Silva, JA Bonacin, M do Carmo Gonçalves; University of Campinas – UNICAMP, Brazil
- 2116 *Volatile p-Nitroaniline as Matrix for High Spatial Resolution Imaging of Phospholipids in Both Ion Modes by AP-MALDI-IMS*; S Matsushita, E Sugiyama, T Hayasaka, N Masaki, M Setou; Hamamatsu University School of Medicine, Japan
- 2118 *Nucleated Growth of Iron Pyrite on Highly Oriented Pyrolytic Graphite (HOPG) by Chemical Vapor Deposition (CVD)*; YJ Kwon, JC Hemminger; University of California, Irvine
- 2120 *Magnetic Arrays Produced by Electron Beam Nanolithography from  $Fe_3O_4$  Compressed Nanoparticles Targets*; G Perez; Instituto Nacional de Metrologia, Brazil; EMB Satovitch; Centro Brasileiro de Pesquisas Físicas, Brazil; G Solorzano; Pontifícia Universidade Católica, Brazil

### ***Tech Forum Special Topics***

- 2122 *Choosing a Fluorescence Microscopy Imaging Modality for Live Quantitative Experiments*; TJ Lambert, JC Waters; Harvard Medical School
- 2124 *After Capture: Fundamentals of Images, their Storage, Visualization, Processing and Quantification*; SA Johnson; Duke University
- 2126 *A Picture is Worth a Thousand Words but Quantitation is Worth a Thousand Micrographs*; W Gray (Jay) Jerome; Vanderbilt University School of Medicine
- 2128 *Live-cell Imaging Using Fluorescence Microscopy*; V DesMarais; Albert Einstein College of Medicine
- 2130 *Measuring Protein Interactions Using Förster Resonance Energy Transfer and Fluorescence Lifetime Imaging Microscopy*; RN Day; Indiana University School of Medicine

### ***Tech Forum Roundtable***

- 2132 *Technologists' Forum Roundtable Discussion: Doing Great Science on a Tight Budget*; JP Chandler; Colorado School of Mines

### ***Tutorial: STEM\_CELL: (S)TEM Software for Supercell Manipulation and Image Analysis***

- 2134 *A Brief Tutorial for the STEM-CELL Software*; V Grillo; CNR-Istituto Nanoscienze, Italy; E Rotunno, M Campanini; CNR- Istituto Materiali per Elettronica e Magnetismo, Italy; MC Spadaro, S d'Addato; Università di Modena e Reggio Emilia, Italy

### ***Tutorial: Imaging of Magnetic Structures in Scanning and Conventional TEM***

- 2136 *EMCD - Magnetic Chiral Dichroism in the Electron Microscope*; P Schattschneider; Vienna University of Technology, Austria; Ecole Centrale Paris, France

## ***Tutorial: Filling the Missing Wedge***

2138 *Template Matching, Alignment and Averaging of Sub-Tomograms in Electron Cryo-Tomography Reconstructions using Jsubtomo*; JT Huiskonen; University of Oxford, United Kingdom

## ***Tutorial: Getting the Most from your Direct Detection (DD) Camera for Low-Dose TEM***

2140 *Getting the Most out of Direct Detection Cameras for Low-Dose Transmission Electron Microscopy*; A Cheng, J Pulokas, S Dallakyan, A Herold, CS Potter, B Carragher; The Scripps Research Institute

## ***Biological Tutorial - Super Resolution: What Technique Should I Use?***

2142 *Practical Considerations for Single Molecule Localization Microscopy Sample Preparation*; JR Allen, MW Davidson; The Florida State University

## ***Microscopy in the Classroom***

2144 *Science Museum and University Collaborations for Public Engagement – the Nanoscale Informal Science Education Network (NISE Net)*; L Bell; Museum of Science

2146 *Microscopy and Team-based Interdisciplinary Materials Research to Achieve 21<sup>st</sup> Century Skills*; C Broadbridge, T Sadowski, J DaPonte; Southern Connecticut State University; J Garofano; United Technologies Research Center

2148 *Microscopy Society of America Certified Electron Microscopy Technician*; P Kysar; University of California; E Calomeni; Ohio State University

2150 *Microscopy Education and Outreach Through Local Societies and Introductory Courses*; T Fettah Kosar; Harvard University, New England Society for Microscopy

## ***Education***

2152 *Microscopy: “Swiss Army Knife” of Science*; CA Wisner; Missouri University of Science and Technology; DR Sutton; DCFT

2154 *Middle School Classroom Materials–Structure and Failure of Wood: A Computational and Micrographic Examination*; D Shattuck, D Adler, M Buehler; Massachusetts Institute of Technology; V Robertson, M Shibata; JEOL; D Shattuck; Concord Middle School

2156 *Teaching with the Microscopy Society of America’s Sandbox*; CA Zona, C Gorman, W Zawadowski; Hooke College of Applied Sciences; H Ullberg, B Dean; McCrone Associates

2158 *The Benefit and Impact of On-Line Tools for Microscopy and Microanalysis Training and Education in Core Facilities*; M Apperley, PR Munroe, J Shapter, J Muhling, L Soon, SP Ringer, E Grinan, C Frost,

B Cribb; Australian Microscopy and Microanalysis Research Facility, Australia; T White; Nanyang Technological University, Singapore

### ***Sorby Award***

- 2160 *Metallographic and Fractographic Contributions to Understanding Environmentally Assisted Cracking*; S Lynch; Defence Science and Technology Organisation, Australia

### ***My Lab is on Mars: Geochemical Adventures with the Mars Curiosity Rover***

- 2162 *My Lab is on Mars: Geochemical Adventures with the Mars Curiosity Rover*; L Leshin; Worcester Polytechnic Institute

### ***Plenary 2***

- 2164 *Multi-spectral Electron Microprobe - Now and the Future*; CM MacRae, NC Wilson and A Torpy; CSIRO Process Science and Engineering
- 2166 *Advances in Acquisition and Analysis of Hyperspectral Images*; PG Kotula; Sandia National Laboratories
- 2168 *Atomic-Resolution X-ray Analysis in Aberration-Corrected Scanning Transmission Electron Microscopes: Current Limits and Challenges toward Quantification*; M Watanabe; Lehigh University

### ***Plenary 3***

- 2170 *H. G. J. Moseley; the Scientist Who Put the Z in ZAF (and kAB)*; DB Williams; The Ohio State University
- 2172 *Impacts of Atom Probe Tomography on the Electronic and Photonic Device Technology*; CG Park, JH Lee, DH Jang, WY Jung, SM Park; Pohang University of Science and Technology, Korea
- 2174 *Robert E Ogilvie: Inventor, MAS Founder, and Educator*; JI Goldstein; University of Massachusetts
- 2176 *Advances in Electron Energy-Loss Spectroscopy with High Spatial and Energy Resolution*; GA Botton, EP Bellido, M Bugnet, S Prabhudev, S Stambula, SY Woo, G-Z Zhu; McMaster University, Canada; N Gauquelin; University of Antwerp, Belgium; D Rossouw; University of Cambridge, UK; H Zhang, JYT Wei; University of Toronto, Canada

### ***Plenary 4***

- 2178 *Mass Spectrometry of Surfaces Using Ion Beams: Molecular Mapping of (Bio)Polymers*; B Hagenhoff; Tascon GmbH, Germany
- 2180 *Elemental Analysis of Cells and Tissues*; PL Clode; The University of Western Australia, Australia

## Welcome from the Society Presidents

DEAR FELLOW MICROSCOPISTS, MICROANALYSTS, STUDENTS AND FRIENDS, we are pleased to have you attend Microscopy & Microanalysis 2014, August 3–7 at the Connecticut Convention Center in historic Hartford, Connecticut. M&M, serving as the annual meeting of the Microscopy Society of America, the Microanalysis Society, and the International Metallographic Society, continues to be the premier meeting for scientists, technologists, and students who use microscopy or microanalysis in their research, with over 1,100 papers to be presented in 2014. Our joining societies are the Microscopical Society of Canada/ Société de Microscopie du Canada and the International Union of Microbeam Analysis Societies (IUMAS), which is holding its sixth meeting (IUMAS-6) in conjunction with M&M 2014.

The Program Committee for 2014 has assembled an exceptional, diverse scientific program featuring researchers from around the world presenting the latest advances in the biological and physical sciences, techniques and instrumentation. In synchrony with this remarkable program is one of the world's largest exhibitions of state-of-the-art microscopy and microanalysis instrumentation. In addition, there are several educational opportunities during M&M 2014, in particular the excellent Short Courses, a Pre-Meeting Congress on Quantitative Aberration-Corrected Electron Microscopy, both held on Sunday, as well as a number of tutorials, educational outreach events, and the always-popular evening vendor tutorials during the week.

If you are new to M&M or a longtime participant, we feel that M&M 2014 is the perfect place to network with others in your field, to learn the newest techniques, to see the latest exhibits, and to check out future job opportunities.

Sunday night's Opening Reception at the Connecticut Science Center provides an enjoyable start to the meeting. You can renew old friendships and make new acquaintances while enjoying a selection of locally sourced dishes and your favorite beverages. Museum exhibits will be open for you to visit.

The Monday morning plenary session will be highlighted by talks from two extraordinary researchers: Prof. Colin Humphreys who will discuss "How Cutting-edge Atomic Resolution Microscopy Can Help to Solve Some of the World's Energy Problems" and Prof. Brian J. Ford who will present "Living Images from the Birth of Microscopy". In addition, participating Societies will recognize major Meeting award winners as well as student, post-doc and technologist winners. During the week, there will be daily student poster awards acknowledging the talents of the best young researchers in instrumentation & techniques, and biological and physical applications of microscopy & microanalysis.

Hartford is an inviting location with hotels, shops, numerous restaurants and historical sites for your enjoyment. The strong science connection in Hartford influenced its most well-known resident, Mark Twain to write *A Connecticut Yankee in King Arthur's Court* about a time traveler. We hope the science presented at Microscopy & Microanalysis 2014 will inspire you to great things!

Have a wonderful week and we look forward to seeing you next year in Portland, Oregon!

**Jeanette Killius**  
President, MSA



**Kristin Bunker**  
President, MAS



**Richard Blackwell**  
President, IMS



**Anja Geitmann**  
President, MSC/SMC



**Se-Ahn Song**  
President, IUMAS



Welcome to this Microscopy and Microanalysis meeting, M&M 2014 in Hartford, Connecticut!

The Microscopy Society of America, the Microanalysis Society, and the International Metallographic Society, and the Canadian Microscopy Society have excelled in bringing the latest and most innovative applications and instrumental developments from investigators in the biological and physical sciences using microscopy and microanalysis techniques. M&M 2014 features more than 37 symposia covering a broad range of topics, ample educational opportunities in the form of courses/tutorials and pre-meeting events including courses, a congress and a workshop. This year is special as we also welcome the Microscopical Society of Canada and the International Union of Microbeam Analysis Societies (IUMAS) who will hold their IUMAS-6 meeting prior to M&M 2014.

This year we are honored to welcome two world renowned scientists, Professor Sir. Colin Humphreys and Professor Brian Ford as this year's plenary speakers. Professor Humphreys will discuss how electron microscopy and atom probe tomography can save the world; by helping solve some of the world's energy problems and how they can also enable commercial exploitation of materials. His research interests include all aspects of electron microscopy and analysis, semiconductors (particularly gallium nitride), ultra-high temperature aerospace materials and superconductors. His work has ranged from defect image interpretation via electron diffraction theory to developing new electron microscope techniques. During his long and fruitful career, Prof. Humphreys received several international awards in recognition of his accomplishments, including the MSA Distinguished Scientist Award. He is a long-standing member of the Microscopy Society of America and was inducted as an MSA Fellow in 2009.

Our second plenary speaker is Prof. Brian Ford, an independent research biologist, author, and lecturer who regularly publishes on scientific issues for the general public. He has also been a television personality for more than 40 years. One of his best-known discoveries was of the original specimens of Antony van Leeuwenhoek, which were well preserved within the collections of the Royal Society of London since the seventeenth century. Prof. Ford's fabulous lecture will be "Images from the earliest microscopes ever made". A Fellow and Member of Court at Cardiff University, Brian is a former Fellow at the Open University, Visiting Professor at the University of Leicester and a Member of the Senior Combination Room at Gonville and Caius College, Cambridge University, where he is currently based.

This year we have two named symposium to honor the life and work of Oliver Wells and Gérard Simon. Oliver C. Wells, who was a champion of all things related to the SEM, was Sir Charles Oatley's second PhD student at Cambridge University to work on the SEM (after Dennis McMullan) and is considered one of the founding fathers of the field. He was a particularly appreciated researcher and analyst who was willing to try something new or different even when all the experts of the day had already dismissed the idea. He was a tinkerer and had a passion for electron detectors. He had great respect for the analyst who was knowledgeable about the SEM and could obtain a plethora of information about a sample by varying all the controllable microscope parameters. He enjoyed meeting to discuss the SEM, always encouraged people to publish their work, and strove to give credit to individuals who were overlooked for significant work. His pioneering work and life will be celebrated in a memorial symposium bearing his name.

To honor Dr. Wells', his memorial session solicited papers on a wide range of topics central to his legacy: "low loss" electron imaging, energy filtered imaging, very high energy imaging, the origin of secondary electrons, new electron detectors, novel uses for established detectors, reducing sample charging in the SEM, and varying SEM analysis conditions to show different information about a sample. Since Dr. Wells was one of the "fathers" of the SEM, the session is also intended to showcase the evolution of the SEM and show how the SEM has contributed to society as a whole. Dr. Wells was also the grandson of H.G. Wells.

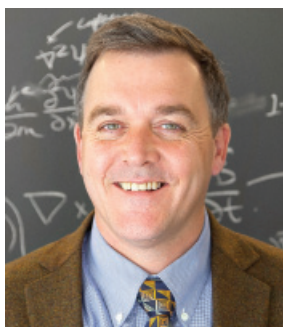
Our other memorial session honours Professor Gérard T. Simon who made many contributions to the development of microscopy in Canada. Born in Switzerland in 1931, Gerard T. Simon began a successful career as a professor of medicine at the University of Geneva where he created the first electron microscopy laboratory in the Department of Pathology. In 1967, he immigrated to Canada with his family where he became director of the Department of Electron Microscopy of the Banting Institute in Toronto.

The career of Gerard T. Simon led him to take over the electron microscopy laboratory of the Faculty of Health Sciences at McMaster University in Hamilton. In recognition of the exceptional accomplishment of Professor Simon in the Microscopical Society of Canada, a merit scientific award named after him is given annually to students in the fields of biological, physical and material sciences. When he retired in 1996, the Honourable Jean Chrétien, Prime Minister of Canada presented him an award in recognition of his professional achievement.

This year's M&M promises to be one of the most exciting meetings ever. The Executive Program Committee and the Symposia Organizers have done a wonderful job planning the 2014 meeting. Each year we enhance and strengthen the Societies that come together to share and collaborate on scientific knowledge.

It is time for us to join together and participate in M&M 2014 as Mark Twain wrote of the city of Hartford in 1868, "Of all the beautiful towns it has been my fortune to see this is the chief." The 2014 M&M meeting promises to be the chief meeting of the year. The Executive Program Committee welcomes you to a celebration of microscopy and microanalysis in the city of Hartford, CT on Aug 3<sup>rd</sup> – Aug 7<sup>th</sup> 2014.

# Executive Program Committee



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Program Vice Chair  
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A.C. Dohnalkova	Pacific Northwest National Laboratory	Adam Robinson	University of Cambridge
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H. Lichte	Technische Universität Dresden	R. Wuhrer	University of Western Sydney
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F. Macaluso	Albert Einstein College of Medicine	S. Zaefferer	Max-Planck-Institut für Eisenforschung GmbH
C.M. MacRae	CSIRO-Minerals	H. Zheng	Lawrence Berkeley National Laboratory
M.B. Matthews	Atomic Weapons Establishment UK	Y. Zhu	Brookhaven National Laboratory



## How Cutting-Edge Atomic Resolution Microscopy Can Help to Solve Some of the World's Energy Problems

Colin Humphreys

*Department of Materials Science and Metallurgy, University of Cambridge, Cambridge, CB3 0FS, UK*

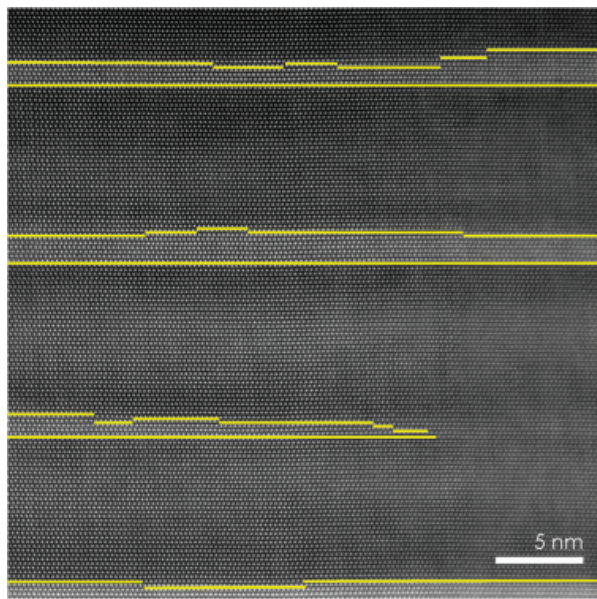
The world's energy demands are growing more steeply now than at any time in the last 200 years (when detailed records began). They are being driven by an increase in the world's population and by increased usage of cars, planes, mobile phones, etc. Fortunately the world's energy supply is greater than had been expected because of the recent exploitation of shale gas and oil. However, for the world as a whole there is an increasing gap between energy demand and supply.

The most effective way to close the gap between energy demand and supply is improved energy efficiency. The US Department of Energy has surveyed all the ways in which electricity is used and concluded that the area with the largest energy savings potential is LED lighting. This talk will show how cutting edge microscopy has been essential to develop low-cost high-efficiency LED lighting based on gallium nitride (GaN). GaN is also important for next-generation high-efficiency power electronic devices. Potentially about 25% of our electricity consumption can be saved using such energy efficient LEDs and power electronic devices. GaN is also important for next-generation solar cells. The ternary alloy InGaN has a bandgap that covers most of the solar spectrum (bandgap of InN is 0.7 eV and of GaN is 3.4 eV). Multi-junction solar cells made from InGaN have a theoretical efficiency of over 70% and hence show huge promise for renewable solar energy.

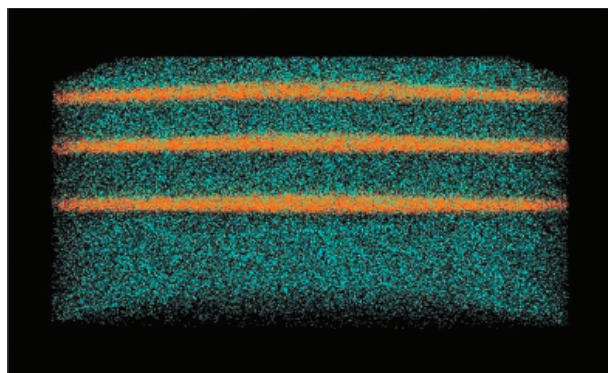
The light-emitting layers in GaN LEDs are quantum wells (QWs) of InGaN sandwiched between GaN barriers. The QWs emit blue light and a covering phosphor converts this to white. Bright emission is obtained for dislocation densities as high as  $10^9 \text{ cm}^{-2}$ , while for all other light-emitting semiconductors the dislocation density has to be less than  $10^3 \text{ cm}^{-2}$ , or the dislocations, as non-radiative recombination centres, quench the light emission. It was thought that nm-sized In-rich clusters in the QWs localised the carriers (electrons and holes) and prevented them from diffusing to the dislocations. However, such clusters, observed in electron microscopy, were shown to be an artefact of electron-beam damage [1], changing the accepted understanding of why GaN LEDs are so efficient with high dislocation densities.

So what mechanism is localising the carriers in the InGaN quantum wells? Aberration corrected electron microscopy was required to show that the quantum wells contained monolayer-height surface steps, and theoretical calculations showed that these would localise the electrons [2]. By varying the growth conditions, the density of monolayer-height surface steps can be controlled (Figure 1). Since electron microscopy showed that InGaN QWs do not contain Indium-rich clusters, InGaN is probably a random alloy. Another form of microscopy, atom probe tomography (APT), was used to confirm this [3] (Figure 2). Data from electron microscopy and APT were then used in quantum mechanical calculations to show that the holes were strongly localised by random indium fluctuations in the InGaN quantum wells [4]. So microscopy has been essential in understanding the fundamental science of GaN-based LEDs.

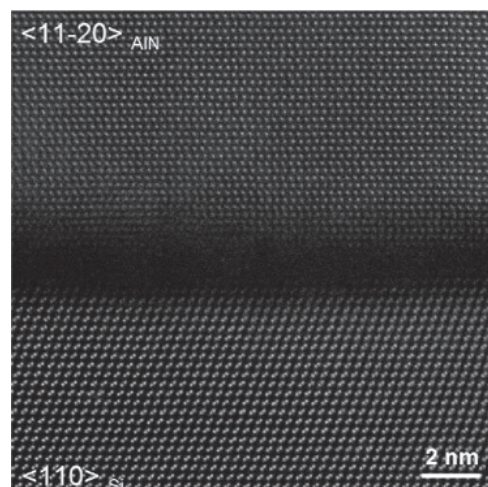
Microscopy then became essential in the technological development of GaN-based LEDs. The main factor preventing the widespread use of LED lighting in our homes and offices is cost. A 60W equivalent replacement LED bulb currently costs about \$15, which most people will not spend. GaN LEDs are currently expensive because they are grown on small diameter (2-inch or 4-inch) sapphire or SiC substrates. Substantial cost reductions are possible if they are grown on 6-inch Si substrates. However GaN cannot be grown directly on Si because it reacts to form a Ga-Si alloy, so an AlN nucleation layer is first grown on the Si. The quality of the AlN/Si interface turns out to be very important and aberration corrected microscopy was again essential to show the existence of a 2 nm thick amorphous layer at the interface (Figure 3). Electron energy loss elemental images were



**Figure 1.** InGaN QWs showing monolayer interface steps. Cs corrected Titan 80-300 HAADF image courtesy of SL Sahonta.



**Figure 2.** APT image of InGaN quantum wells and GaN barriers. In atoms orange, Ga atoms green.



**Figure 3.** AlN on Si showing amorphous  $\text{Si}_x\text{N}_y$  layer at the interface. Cs corrected Titan 80-300 HAADF image.

then used to show that this layer was  $\text{Si}_x\text{N}_y$  [5]. Thus advanced electron microscopy techniques have been essential to understand the science of GaN LEDs and to develop the technology. If widely used, such LEDs will save 10-15% of electricity.

Advanced electron microscopy is similarly proving invaluable in developing GaN-based power electronic devices. If widely used these would save a further 9% of electricity. We can also expect that electron microscopy will be important in the future development of InGaN solar cells, which have the potential to be the most efficient solar cells in the world. Thus electron microscopy has a vital role to play in solving the world's energy problems.

#### References:

- [1] TM Smeeton *et al*, Appl. Phys. Lett., **83** (2003), 5419.
- [2] DM Graham *et al*, J. Appl. Phys., **97** (2005) 103508.
- [3] MA Galtrey *et al*, Appl. Phys. Lett., **90** (2007) 061903.
- [4] D Watson-Parris *et al*, Phys. Rev. B, **83** (2011) 115321.
- [5] G Radtke *et al*, Appl. Phys. Lett., **100** (2012) 011910.



**Colin Humphreys**

Professor Humphreys is Director of Research in the Department of Materials Science and Metallurgy, University of Cambridge. He is also the Director of the Cambridge Centre for Gallium Nitride and the Rolls-Royce/Cambridge University Technology Partnership for Advanced Aerospace Materials. His early work in electron microscopy focused on using electron diffraction theory to interpret the images of defects in a wide range of materials and he also developed new electron microscope techniques. More recently he has used electron microscopy and atom probe tomography (APT) for the advanced characterisation of materials. In this talk he will show how atomic resolution electron microscopy and APT can be used to help to solve some of the world's energy problems and can also enable the commercial exploitation of materials.

## How Pioneering Natural Philosophers Observed the Microscopical World

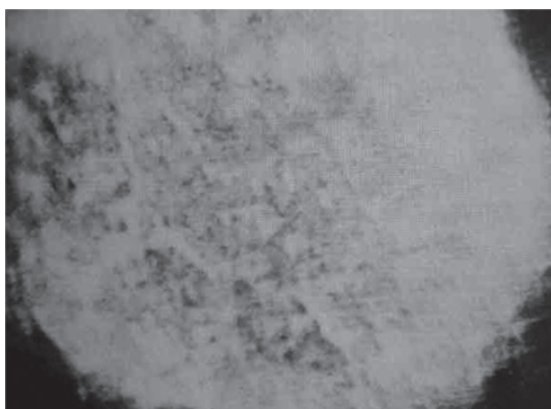
Brian J Ford

*Fellow, Cardiff University. Rothay House, Mayfield Road, Eastrea, Cambridge PE7 2AY*

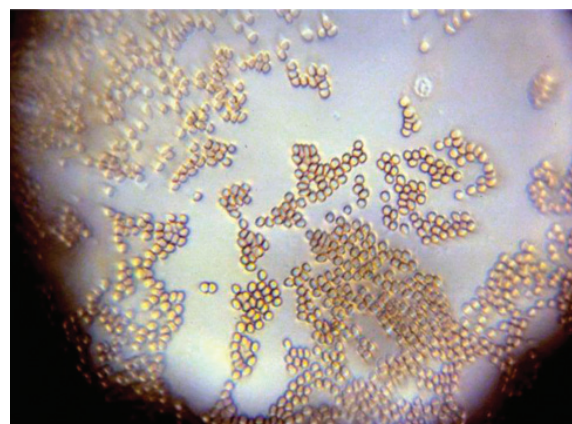
This research has determined how microscopy began. Until the mid-17th century, no investigator had glimpsed the complexity of living cells, or discerned the communities of microscopic organisms that are everywhere around us. Since that time, many scientific works and television programs have reported how difficult it was to make useful observations through the early microscopes. It has now been shown that this was not due to deficiencies in instruments. When used correctly they reveal extraordinary detail.

Science has lost the knowledge needed to tease the best images from these remarkable, pioneering instruments. When used correctly, the earliest microscopes are now shown to reveal a remarkable degree of resolution [1]. In the four examples below, original ancient lenses have been used. Figures 1 & 2 were taken with the Leeuwenhoek single lens microscope from Utrecht University (*circa* 1690); figures 3 & 4 are taken with Robert Brown's microscope (dating from 1827).

Video allows us to savor the appearance of specimens in real time, and innovative techniques have now been devised that allow us to reprise the way in which specimens appeared to the pioneering investigators. The initial results were presented at the Royal Society, London, in 2010 [2].



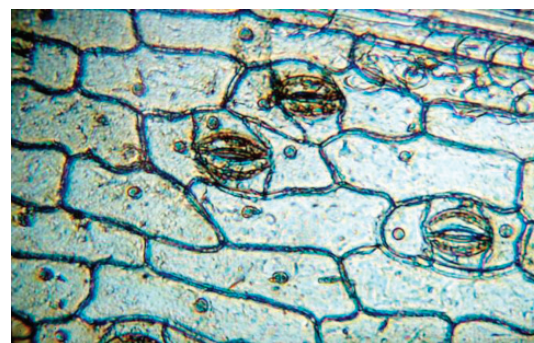
**Figure 1.** One of Leeuwenhoek's original microscopes is now preserved at Utrecht. This is the conventional view of a human blood specimen photographed through this instrument, dating from about 1690. No detail can be seen.



**Figure 2.** Used correctly, the microscope can generate this highly detailed image. There is a scattering of many red cells (erythrocytes) and, top right, a white cell (leucocyte) and its nucleus can be clearly discerned.



**Figure 3.** The recent BBC Television series entitled 'Cell' attempted to recreate the first observations that Robert Brown made of the cell nucleus in 1827. This is the result of their major six-figure budget: for all the effort and the BBC's technical expertise, little detail can be seen.



**Figure 4.** Using the same microscope, this is the remarkable amount of detail that Brown's microscope can reveal when set up correctly. Not only is the nucleus in each cell easily seen, but details of the stomata—the leaf's breathing pores—can also be resolved with ease.

### References:

[1] B J Ford, Did physics matter to the pioneers of microscopy? *Advances in Imaging and Electron Physics*, **158**: 27-87, 2009, New York: Academic Press.

[2] B J Ford, Revolutionary insights—the dawn of microscopical investigation, lunchtime lecture to Royal Society of London, October 29, 2010.



**Brian J Ford**

Brian J Ford is a prolific research scientist who launched major science programs for the BBC. His books pioneer new approaches in bringing science to the public. He was a NESTA Fellow 2004–2007, was presented with the inaugural Köhler medal in America for his work in microscopy, and has been nominated for the prestigious Faraday Medal of the Royal Society in London. He studied biology at Cardiff University, but left University to establish his own laboratory to work on a new interdisciplinary approach to scientific research. He was elected a Fellow of Cardiff University in 1986, has been a Member of the University Court since 1981, and has been President of the Association of Past Students. He has made unique contributions to science and is a world authority on the microscope (the subject of many of his best-selling books). He pioneered regular ‘science reports’ on television news, went on to introduce regular science to BBC radio and then launched his own programs. Ford’s work has revolutionized many major areas of science. His BBC programs (*Science Now*, for instance) broke new ground in the public accessibility of science and were enthusiastically reviewed. His major TV series *Food for Thought* was in the network top ten within its second week of transmission; it was widely used as a teaching aid in schools. Another pioneering title was *Microbe Power - Tomorrow’s Revolution*, for this painted a detailed portrait of the importance of microorganisms. Ford’s microscope books, from *Revealing Lens* and *Optical Microscope Manual* to the more recent *Single Lens* and *Leeuwenhoek Legacy* have changed our understanding of the development of this important branch of science. In England he was highly influential as a Director of Mensa, and a member of Council and a Director of the National Science Centre project, whilst in the USA he has served on the boards of the McCrone Research Institute and the Van Leeuwenhoek Institute, has been appointed adviser to the National Science Foundation and is an Emeritus Fellow of the New York Academy of Science. At Cambridge University he is President of the Society for the Application of Research, and a member of Council of the Friends of the University Library. Among many posts, he held a Fellowship at the Open University 2001–2004; he is based at Gonville and Caius College, Cambridge University and is an honorary Member of Keynes College at the University of Kent. Recently he produced a microscope manual given to British schools as part of Science Year, and has published a book on GM crops that received enthusiastic reviews. Currently he has a 20,000 word chapter in press for a major physics textbook and has published several papers on the intelligence of living cells.

## 2014 Officers

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			Bill Russin
			Mark A. Sanders
		Director, Local Affiliated Societies	Alice Dohnalkova

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Diagnostic Microscopy	Michael Goheen	Nominating Committee Chair	Ernest Hall
Electron Crystallography and	Sergei Rouvimov	Placement Office	Pamela F. Lloyd
Automated Mapping Techniques		Publications Liaison	Jeanette Killius
Environmental TEM	Judith C. Yang	Sustaining Members Chair	Noel T. (Tom) Nuhfer
Facilities Management & Operations	Randy Nessler	Technologists' Forum	John P. Chandler
Focused Ion Beam	Brian Gorman	Association Management	Robert Dziuban
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International Committee Chair	Raynald Gauvin		Manager
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			Corcoran Expositions, Inc.

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4D Technology Corporation	FEI Company	Micron, Inc.
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Duniway Stockroom Corp.	Mager Scientific, Inc.	Tescan USA Inc.
E.A. Fischione Instruments Inc.	Materials Analytical Services	Thermo Fisher Scientific Inc.
EDAX Inc	Micro Star Technologies, Inc.	Tousimis Research Corporation
Electron Microscopy Sciences		XEI Scientific, Inc.
EXpressLO LLC		

## MSA Outstanding Technologists' Awards

1993	Ben O. Spurlock	1999	John C. Wheatley	2007	Thomas Deerinck
1994	Bernard J. Kestel		John M. Basgen	2009	Lynne Gignac
1995	Kai Chien	2000	Nancy Crise Smith		Mary Morphew
1996	David W. Ackland	2001	Conrad G. Bremer	2010	E. Ann Ellis
1997	John P. Benedict	2002	José A. Mascorro	2011	Robert Grassucci
	Stanley J. Kepeis	2003	Edward A. Ryan	2012	Kunio Nagashima
1998	Charles J. Echer	2004	Mark C. Reuter	2013	Robyn Roth
	Hilton H. Molehauer	2005	Chris Nelson		K. Shawn Reeves
			John J. Bozzola		

## Morton D. Maser Distinguished Service Award

1992	Ronald Anderson	1993	E. Laurence Thurston	2003	M. Grace Burke
	G.W. Bailey	1994	Richard Crang	2004	Ralph Albrecht
	Frances Ball	1995	Raymond K. Hart	2005	W. Gray (Jay) Jerome
	Blair Bowers	1996	José Mascorro	2006	Jeanette Killius
	Deborah Clayton	1997	William T. Gunning III	2007	Robert L. Price
	Joseph Harb	1998	Nestor J. Zaluzec	2008	Stuart McKernan
	Kenneth Lawless	1999	Charles Lyman	2009	Pamela Lloyd
	Morton D. Maser	2000	Barbara A. Reine	2011	Janet Woodward
	Caroline Schooley		Hildegard H. Crowley	2012	Gina Sosinsky
	John H.L. Watson	2002	Beverly Maleeff	2013	Caroline Miller

### Albert Crewe Award

2012	Wu Zhou
2013	Lena Fitting-Kourkoutis

### George Palade Award

2012	Gabriel Lander
2013	Peng Ge

**DISTINGUISHED SCIENTIST AWARDS****Biological Sciences**

Wah Chiu

**Dr. Wah Chiu** is the Distinguished Service Professor of Biochemistry and Director of the National Center for Macromolecular Imaging at Baylor College of Medicine. He is the founding director of the Graduate Program in Structural and Computational Biology and Molecular Biophysics at Baylor College of Medicine. He received a Bachelor of Arts in Physics in 1969 and a Ph.D. in Biophysics in 1975 at the University of California, Berkeley. He was trained under the mentorship of Professor Robert M. Glaeser.

Dr. Chiu is a pioneer in methodology development for electron cryo-microscopy. His work has transformed single particle electron cryo-microscopy into a routine tool for the structural determination of macromolecular machines at near atomic resolution. Using his technologies, he has collaborated with many eminent scientists around the world.

Dr. Chiu has earned several honors including the elected member of the Academia Sinica, Taiwan in 2008, the United States National Academy of Sciences in 2012, and the Academy of Medicine, Engineering, and Science of Texas in 2013. He won the Distinguished Faculty Award from the Baylor College of Medicine Alumni Association in 2013. He is the awardee of the Honorary Doctorate of Philosophy, University of Helsinki, Finland in 2014.

**Physical Sciences**

David J. Smith

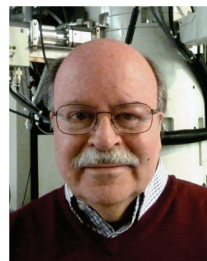
**Dave Smith** is Regents' Professor of Physics at Arizona State University. He received his Ph.D. in Physics (1978) and D.Sc. (1988) from the University of Melbourne, Australia. He has served as Director, Cambridge University High Resolution Electron Microscope (1980 to 1984) and Director, ASU Center for High Resolution Electron Microscopy (1991 to 2006), and he was President, Microscopy Society of America (2009). He is the author/co-author of 20 book chapters and over 500 refereed journal publications, he is a Fellow of MSA, MRS, APS and IoP (U.K.), and Editor (Materials), Microscopy and Microanalysis (since 2004). His long-term research interests have centered on the development and applications of atomic-resolution electron microscopy, with recent interests in oxide/semiconductor heterostructures and magnetic thin films and nanostructures.



**Burton Medal Award**

Maria Varela

**Maria Varela** obtained her BS (1997) and PhD (2001) in Physics at the Complutense University, Madrid, Spain. She joined Oak Ridge National Laboratory as a Wigner Fellow in 2002 and has been a Research Staff Member in the Materials Science and Technology Division since 2004. In 2010 she also became a Professor at Complutense University of Madrid after being the recipient of an European Research Council Starting investigator Award. Her research experience includes thin film growth, transport properties and structural characterization by x ray diffraction and electron microscopy, specializing in aberration corrected scanning transmission electron microscopy and atomic resolution energy-loss spectroscopy. Her main research interests include a variety of topics related to magnetism and complex oxide nanosystems, thin films and superlattices, including high T<sub>c</sub> superconductors, colossal magnetoresistance materials, multiferroics, and other cutting edge materials.

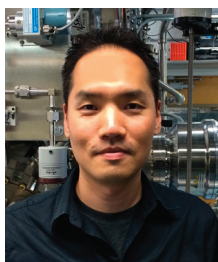


**Morton D. Maser  
Distinguished Service Award**

Mike Marko

**Mike Marko** has been an electron microscopist for 41 years and an (E)MSA member for 34 years. A founding staff member of the HVEM lab (in 1976), and the NIH Biotechnological Resource (in 1981) he remains a Research Scientist at Wadsworth Center, in Albany, NY, where he is currently manager of the “3D-EM Facility”. He is currently pursuing two instrument-development projects (cryo-FIB preparation for cryo-TEM; TEM phase-plate imaging).

For MSA, he has organized M&M symposia since 2001. He has been Archivist since 2002 and has served on the Awards, Education, Nominating, and Program Committees. He was Program Chair for M&M 2007. He has organized the M&M Sunday Short courses and In-Week Workshops since 2008. He served on Council from 2009 to 2011. He is also a founding member, past Secretary and past President of the Capital District Microscopy and Microanalysis Society.



**Albert Crewe Award**

Jinwoo Hwang

**Jinwoo Hwang** received his Ph.D. from the University of Wisconsin, Madison in 2011. He is currently a postdoctoral researcher at the University of California, Santa Barbara. His research interests include advanced structural characterization of materials, S/TEM technique development, and computational materials modeling. In particular, he has developed novel S/TEM techniques and simulation methods based on electron nanodiffraction and quantitative imaging, for nanostructured materials, oxide heterostructures, and non-crystalline materials. For his contributions to the field, he has received several honors and awards, including a best postdoctoral paper award from the Microscopy and Microanalysis Society in 2013.



**George Palade Award**

Ricardo Guerrero-Ferreira

**Ricardo Guerrero-Ferreira** is a postdoctoral scientist in the Laboratory of Structural Biology and Biophysics at the *École Polytechnique Fédérale de Lausanne* (EPFL) in Switzerland. I received my B.Sc. from *Universidad del Atlántico* in Barranquilla, Colombia in 1999 and my PhD from New Mexico State University in 2008. During my PhD I worked with Dr. Michele K. Nishiguchi on the ecology, evolutionary biology and structural biology of marine symbiotic bacteria. I was a postdoctoral researcher at the laboratory of Dr. Elizabeth Wright at Emory University where I investigated bacteria-bacteriophage interaction using cryo-electron microscopy and cryo-electron tomography, as well as the application of Zernike phase-contrast cryo-electron tomography to study the ultrastructure of whole bacterial cells. I joined the laboratory of Dr. Petr Leiman at EPFL in 2013 to study the structure of the adsorption apparatus of bacteriophages and their structural modifications during infection using single particle analysis and cryo-electron tomography





**Hildegard H. Crowley**  
**Outstanding Technologist**  
**Award for Biological**  
**Sciences**

Hong Yi

**Hong Yi** is the technical director of the Robert P. Apkarian Integrated Electron Microscopy Core at Emory University. She holds a Masters Degree from Iowa State University where she received extensive education and training in electron microscopy under Dr. Jack Horner. She then worked in the Center for Electron Microscopy Research at the University of Iowa.

Hong's main interest is in the area of biological immunoelectron microscopy. She was one of pioneers in the application of ultrasmall gold conjugates in pre-embedding immuno-gold labeling. She later developed a double pre-embedding immuno-gold labeling method that incorporated two ultrasmall gold conjugates. She has also been active in teaching immunoelectron microscopy. To extend the applicability of labeling methods, Hong has also been involved in developing the technology of self-pressurized rapid freezing (SPRF) of biological materials. Currently, Hong is establishing methods for native immuno-gold labeling for cryo-electron microscopy and cryo-electron tomography applications.



**Chuck Fiori Outstanding**  
**Technologist for Physical**  
**Sciences**

Eddy Garcia-Meitin

**Eddy I. Garcia-Meitin** is a Technologist Leader for the Macromolecular Characterization group of Analytical Sciences at the Dow Chemical Company. He specializes in morphological characterization of polymers with a focus on failure analyses utilizing optical, transmission and scanning electron microscopies. He enjoys working across multiple business functions and applies an interdisciplinary approach to problem solving and new product development. During his 35 year career at Dow, Garcia-Meitin has familiarized himself with many different chemical product families including polyethylene, polypropylene, polyurethane, polyolefin elastomers, toughened epoxies and nanocomposite-hybrid materials. Garcia-Meitin was the recipient of the 2005 ACS National Chemical Technician Award. He has co-authored over 40 external publications, chapters in three polymer toughening handbooks and is co-inventor on 9 US patents. He and his wife Cindy have three daughters and reside in Angleton, Texas

## MSA Fellows

### 2009

Adrian, Marc  
Anderson, Ron  
Bentley, James  
Burke, Mary Grace  
Carpenter, Ray W.  
Carter, C. Barry  
Crewe, Albert V.  
De Graef, Marc  
Dravid, Vinayak, P.  
Dubochet, Jacques  
Echlin, Patrick  
Egerton, Raymond F.  
Farquhar, Marilyn G.

Fawcett, Don W.  
Frank, Joachim  
Gaeser, Robert M.  
Glauert, Audrey M.  
Hart, Raymond Kenneth  
Hashimoto, Hatsujiri  
Henderson, Richard  
Hirsch, Peter B.  
Howie, Archibald  
Huxley, Hugh E.  
Ichinokawa, Takeo  
Iijima, Sumio  
Inoue, Shinya

Joy, David C.  
Karnovsky, Morris J.  
Klug, Aaron  
Krivanek, Ondrej L.  
Ledbetter, Myron C.  
McMullan, Dennis  
Michael, Joseph  
Richard  
Miller, Sara Elizabeth  
Mitchell, Terrence E.  
Mulvey, Thomas  
Newbury, Dale E.  
Rempfer, Gertrude

Revel, Jean-Paul  
Rose, Harald  
Schmitt, F.O.  
Schooley, Caroline  
Shimizu, Ryuichi  
Silcox, John  
Sinclair, Robert  
Singer, S.J.  
Sjostrand, Fritiof  
Smith, Kenneth C.A.  
Somlyo, Avril V.  
Spence, John C.H.  
Steven, Alisdair

Swann, Peter R.  
Thomas, Gareth  
Tokuyasu, Kiyoteru  
Unwin, Nigel  
Wall, Joseph S.  
Wells, Oliver  
Whelan, Michael J.  
Zaluzec, Nestor J.  
Zeitler, Elmar  
Zhu, Yimei

### 2010

Ralph M. Albrecht  
Lawrence F. Allard  
Kenneth H. Downing

E. Ann Ellis  
Joseph I. Goldstein  
Michael Isaacson

Michael K. Miller  
George Pappas  
Stephen J. Pennycook

John P. Petrali  
Zhong L. Wang  
David B. Williams

### 2011

P.E. Batson  
P.G. Calarco  
P.A. Crozier  
J.A. Eades

B.J. Griffin  
W.T. Gunning III  
W.G. Jerome

R.E. Leapman  
C.E. Lyman  
M.A. O'Keefe

G. Perry  
R.B. Simmons  
J.H. Woodward

### 2012

U. Dahmen  
M. Goldstein  
M. Kim

W. Landis  
J. Liu  
B. Maleeff

R. Price  
F. Ross  
D. Seidman

D. Sherman  
N. Yao

### 2013

N. Browning  
H. Fraser  
D. Muller

M. Radermacher  
D. Smith  
E. Stach

### 2014

G. Botton  
A. Datye  
M. Gajdardziska-Josifovska

L.A. Giannuzzi  
T. Kelly  
J. Mansfield

M. McCartney  
X. Pan  
D. Piston

## Past Award Winners

### MSA Distinguished Scientist Awards

#### Biological Sciences

1975 Keith Porter  
 1976 L.L. Marton  
 1977 Robley C. Williams  
 1978 Thomas Anderson  
 1979 Daniel C. Pease  
 1980 George E. Palade  
 1981 Sanford L. Palav  
 1982 Richard M. Eakin  
 1983 Hans Ris  
 1984 Cecil E. Hall  
 1985 Gaston Dupouy  
 1986 F.O. Schmitt  
 1987 Marilyn G. Farquar  
 1988 Morris J Karnovsky  
 1989 Don W. Fawcett  
 1990 Audrey M. Glauert  
 1991 Hugh E. Huxley  
 1992 Fritiof Sjöstrand  
 1993 Jean-Paul Revel  
 1994 Andrew P. Somlyo  
 1995 Shinya Inoue  
 1996 Myron C. Ledbetter  
 1997 S. J. Singer  
 1998 Avril V. Somlyo  
 1999 Sir Aaron Klug  
 2000 K. Tokuyasu  
 2001 Patrick Echlin  
 2002 Marc Adrian  
 2003 Joachim Frank  
 2004 Robert M. Glaeser  
 2005 Richard Henderson  
 2006 Joseph S. Wall  
 2007 Nigel Unwin  
 2008 Alasdair Steven  
 2009 Jacques Dubochet  
 2010 George Pappas  
 2011 Ueli Aebi  
 2012 Tim Baker  
 2013 David DeRosier

#### Physical Sciences

Robert Heidenreich  
 Albert Crewe  
 James Hillier  
 Vernon E. Cosslett  
 John M. Cowley  
 Gareth Thomas  
 Vladimir K. Zworykin  
 Benjamin M. Siegel  
 Otto Scherzer  
 Sir Charles Oatley  
 Ernst Ruska  
 Peter Hirsch  
 Jan B. LePoole  
 Hatsujiro Hashimoto  
 Elmar Zeitler  
 Gertrude F. Rempfer  
 Archie Howie  
 Oliver C. Wells  
 Kenneth C.A. Smith  
 Dennis McMullan  
 David B. Wittry  
 John Silcox  
 Peter R. Swann  
 Michael J. Whelan  
 Takeo Ichinokawa  
 S. Amelinckx  
 Thomas Mulvey  
 Ryuichi Shimizu  
 Harald Rose  
 Raymond F. Egerton  
 Sumio Iijima  
 John C.H. Spence  
 Terence E. Mitchell  
 Ondrej L. Krivanek  
 Robert Sinclair  
 Michael Isaakson  
 Hannes Lichte  
 Ulrich Dahmen  
 C. Barry Carter

### MSA Burton Medal

1975 James Lake  
 1976 Michael S. Isaakson  
 1977 David D. Joy  
 1978 Robert Sinclair  
 1979 Norton B. Gilula  
 1980 John C.H. Spence  
 1981 Barbara J. Panessa-Warren  
 1982 Nestor J. Zaluzec  
 1983 Ronald Gronsky  
 1984 David B. Williams  
 1985 Richard D. Leapman  
 1986 J. Murray Gibson  
 1987 Ron A. Milligan  
 1988 A.D. Romig, Jr.  
 1989 Laurence D. Marks  
 1990 W. Mason Skiff  
 1991 Joseph R. Michael  
 1992 Kannan M. Krishnan  
 1993 Joseph A.N. Zasadzinski  
 1994 Jan M. Chabala  
 1995 Joanna L. Batstone  
 1996 Vinayak P. Dravid  
 1997 P.M. Ajayan  
 1998 Ian M. Anderson  
 1999 Zhong Lin Wang  
 2000 Eva Nogales  
 2001 Jian Min Zuo  
 2002 Nigel D. Browning  
 2003 Frances M. Ross  
 2004 Z. Hong Zhou  
 2005 David J. Larson  
 2006 David A. Muller  
 2007 Peter D. Nellist  
 2008 Steven J. Ludtke  
 2009 Eric Stach  
 2010 Sergei Kalinin  
 2011 Radostin Daney  
 2012 David Ginger  
 2013 John L. Rubinstein

# Microanalysis Society

**Established 1966**

doi:10.1017/S1431927614001196

## Officers 2014

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 President Elect Thomas F. Kelly  
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### MAS Past Presidents

1968 L.S. Birks	1980 O.C. Wells	1991 J.T. Armsrong	2002 G.P. Meeker
1969 K.F.J. Heinrich	1981 J.R. Coleman	1992 D.B. Williams	2003 E.S. Etz
1970 R.E. Ogilvie	1982 R.L. Myklebust	1993 T.G. Huber	2004 P.K. Carpenter
1971 A.A. Chodos	1983 R. Bolon	1994 J.A. Small	2005 I.H. Musselman
1972 K. Keil	1984 D.C. Joy	1995 J.J. McCarthy	2006 R. Gauvin
1973 D.R. Beaman	1985 D.E. Newbury	1996 D.E. Johnson	2007 P.G. Kotula
1974 P. Lublin	1986 C.G. Cleaver	1997 J.R. Michael	2008 I.M. Anderson
1975 J.E. Colby	1987 C.E. Fiori	1998 R.B. Marinenko	2009 C. Johnson
1976 E. Lifshin	1988 W.F. Chambers	1999 J.J. Friel	2010 E.P. Vicenzi
1977 J.I. Goldstein	1989 D.B. Wittry	2000 C.E. Lyman	2011 J.H.J. Scott
1978 J.D. Brown	1990 A.D. Romig, Jr	2001 R.W. Linton	2012 J.F. Mansfield
1979 D.F. Kyser			2013 Kristin Bunker

### MAS Sustaining Members

Advanced MicroBeam, Inc.	Hysitron, Inc.	Probe Software, Inc.
Bruker Nano	IBSS Group	PulseTor, LLC
CAMECA Instruments, Inc.	IXRF Systems, Inc.	SEMTEC Laboratories, Inc.
Carl Zeiss Microscopy, LLC	JEOL USA, Inc.	SEMTEC Solutions, Inc.
EDAX, Inc.	L.A. Giannuzzi & Associates, LLC	South Bay Technologies, Inc.
Electron Microscopy Sciences	Lehigh University	SPI Supplies/Structure Probe, Inc.
FEI Company	Leica Microsystems, Inc.	Ted Pella, Inc.
Gatan, Inc.	Materials Analytical Services, LLC	Thermo Fisher Scientific, Inc.
Geller MicroAnalytical Laboratory	Micron, Inc.	
Hitachi High Technologies America, Inc.	Oxford Instruments, Inc.	

## MAS Awards

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All MAS Awards are recommended by the Awards Committee for approval by either the President or Council.

### **Peter Duncumb Award for Excellence in Microanalysis**

Sponsored by Bruker Nano. The Duncumb Award recognizes outstanding achievement over a sustained period of time in the field of microanalysis through technical accomplishment, leadership, and educational and pro-fessional activities. The award winner is chosen through nomination by the MAS membership and selection by vote of MAS Council.

### **Presidential Service Award**

This award honors a member of MAS for outstanding volunteer service to the society over a sustained period of time. The award winner is chosen annually by the MAS President.

### **Presidential Science Award**

This award honors a senior scientist for outstanding technical contributions to the field of microanalysis over a sustained period of time. The award winner is chosen annually by the MAS President.

### **K. F. J. Heinrich Award**

This award honors a scientist under the age of forty for distinguished technical contributions to the field of microanalysis. The award winner is chosen annually by the MAS President.

### **M&M Student Awards**

These awards are presented annually to students presenting high quality technical papers with significant microanalysis content at the annual meeting. The award is comprised of complimentary registration and significant funds to defray travel expenses to attend the meeting. Application is accomplished by requesting consideration for a student award during the paper submission process. Qualified applicants must be full-time students at an accredited educational institution, must be first author of the paper submitted for consideration, and must present the paper in person at the meeting. MAS Distinguished Scholars receive invitations to attend MAS-sponsored functions throughout the week of the annual meeting, including the Presidents' Reception and the MAS Social. The award winners are chosen annually by the MAS President.

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## MAS Outstanding Paper Awards

These awards are presented annually to the authors of outstanding papers from the previous annual meeting in each of four categories. The four awards are as follows:

- Birks Award, for best contributed paper – Sponsored by JEOL USA. Inc.
- Macres Award, for best instrumentation or software paper – Sponsored by Oxford Instruments, Inc.
- Cosslett Award, for best invited paper – Sponsored by MAS
- Castaing Award, for best student paper. – Sponsored by CAMECA Instruments, Inc.

Candidates for the MAS Outstanding Paper Awards are nominated, through consultation with symposium organizers and the MAS membership, by the MAS Directors in their final year of service at the time of the meeting, then approved by vote of MAS Council.

# MAS Awards

## Previous Award Winners

### Presidential Science

1977 R. Castaing  
 1978 K.F.J. Heinrich  
 1979 P. Duncumb  
 1980 D.B. Wittry  
 1981 S.J. Reed  
 1982 R. Shimizu  
 1983 J. Philibert  
 1984 L.S. Birks  
 1985 E. Lifshin  
 1986 R. Myklebust  
 1987 O.C. Wells  
 1988 J.D. Brown  
 1989 J. Hillier  
 1990 T.E. Everhart  
 1991 J.I. Goldstein  
 1992 G. Lorimer & G. Cliff  
 1993 D.E. Newbury  
 1994 D.C. Joy  
 1995 G. Bastin  
 1996 A.V. Somlyo & A.P. Somlyo  
 1997 D.B. Williams  
 1998 F.H. Schamber  
 1999 R.A. Sareen  
 2000 R.F. Egerton  
 2001 P.E. Batson  
 2002 K. Keil  
 2003 P.E. Russell  
 2004 J.T. Armstrong  
 2005 M. Slodzian  
 2006 B.J. Griffin  
 2007 R.D. Leapman  
 2008 T.F. Kelly  
 2009 J.R. Michael  
 2010 J. Donovan  
 2011 P. J. Statham  
 2012 N. Zaluzec  
 2013 P. Echlin

### Presidential Service

1977 P. Lublin  
 1978 D.R. Beaman  
 1979 M.A. Giles  
 1980 A.A. Chodos  
 1981 R. Myklebust  
 1982 J. Doyle  
 1983 D. Newbury  
 1984 J.I. Goldstein  
 1985 M.C. Finn  
 1986 V. Shull  
 1987 D.C. Joy  
 1988 G. Cleaver  
 1989 W.F. Chambers  
 1990 E. Fiori  
 1991 T.G. Huber  
 1992 E.S. Etz  
 1993 H.A. Freeman  
 1994 J.L. Worrall  
 1995 R.W. Linton  
 1996 P.F. Hlava  
 1997 J.A. Small  
 1998 J.J. McCarthy  
 1999 T.G. Huber  
 2000 R.B. Marinenko  
 2001 C.E. Lyman  
 2002 J.F. Mansfield  
 2003 I.H. Musselman  
 2004 J.R. Michael  
 2005 G. Meeker  
 2006 H.A. Freeman  
 2007 P.K. Carpenter  
 2008 L.M. Ross  
 2009 V. Woodward  
 2010 S. Wight  
 2011 D. Kremser  
 2012 C. Johnson  
 2013 J.J. McGee

### K.F.J. Heinrich

1986 P. Statham  
 1987 J.T. Armstrong  
 1988 D.B. Williams  
 1989 R. Leapman  
 1990 R.W. Linton  
 1991 A.D. Romig, Jr.  
 1992 S. Pennycook  
 1993 P.E. Russell  
 1994 J.R. Michael  
 1995 N. Lewis  
 1997 R. Gauvin  
 1998 V.P. Dravid  
 1999 J. Bruley  
 2000 H. Ade  
 2001 C. Jacobsen  
 2002 D. Wollman  
 2005 M. Watanabe  
 2006 M. Toth  
 2007 G. Kothleitner  
 2008 P.G. Kotula  
 2009 D. Drouin  
 2010 H. Demers  
 2011 L. Brewer  
 2012 E. Marquis  
 2013 J. LeBeau

### Peter Duncumb Award for Excellence in Microanalysis

2007 D.B. Williams  
 2008 J.I. Goldstein  
 2009 D.E. Newbury  
 2010 D. Joy  
 2011 J. Michael  
 2012 J. Bentley  
 2013 E. Lifshin

## MAS 2014 Awards

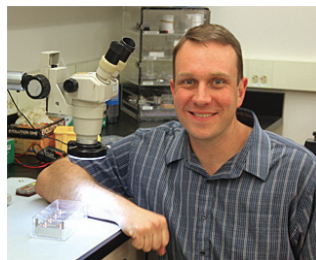


### **Duncumb Award for Excellence in Microanalysis** Ondrej Krivanek

**Ondrej Krivanek** graduated with a B.Sc. in Physics from Leeds University and a Ph.D. from Cambridge University, both in the UK. He was a postdoctoral fellow at Kyoto University, Bell Laboratories and the University of California at Berkeley, assistant professor of Physics at Arizona State University, director of research at Gatan, visiting professor at Tokyo Institute of Technology, CNRS Orsay and Cambridge University, and research professor at University of Washington. In 1997, he co-founded Nion Company near Seattle in Washington State. He has since been Nion's president and more recently also adjunct professor of physics at Arizona State University.

During his post-doc at Berkeley, Ondrej found that he liked thinking up, designing, making and then using pioneering new instruments more than working with existing ones, and later on that instrument development can often be done more effectively in a small company setting than in academia. Instruments whose design he originated, such as Gatan's electron energy loss spectrometers and imaging filters, CCD cameras and DigitalMicrograph software, and more recently electron-optical aberration correctors and Nion's whole electron microscopes and monochromators, can be found in many laboratories around the world, and they have helped to produce many scientific advances. The Nion microscopes in particular have been able to explore matter in unprecedented detail, including, very recently, performing phonon spectroscopy and spectrum-imaging in an electron microscope.

Ondrej has published over 240 papers and book chapters, with over 6000 citations. His work has been honored by an R&D 100 award, the Seto Prize of the Japanese Microscopy Society, the Duddell Prize of the Institute of Physics, the Distinguished Scientist Award of the Microscopy Society of America, an Honorary Fellowship in the Royal Microscopical Society, and an election to the British Royal Society.



### **K.F.J. Heinrich Award** Brian Gorman

**Brian Gorman** is currently an Associate Professor of Materials Science at the Colorado School of Mines. Brian earned his B.S., M. S., and Ph.D. in Ceramic Engineering at the University of Missouri – Rolla (now Missouri S&T) under the direction of Harlan Anderson. After his graduate work, he joined the Department of Materials Science and Engineering at the University of North Texas as a postdoctoral researcher in close collaboration with Texas Instruments. Brian went on to teach at UNT for 5 years while working on summer sabbatical at the National Renewable Energy Laboratory in Golden, CO. He joined the faculty at the Colorado School of Mines in 2009, again working closely with NREL and NIST-Boulder.

Brian's research group focuses on developing and applying correlative atom probe tomography and transmission electron microscopy techniques to determine the atomic scale structure and chemistry of ceramics and semiconductors. Recently, his group has been focusing on ferroelectric and dielectric oxide ceramics, CdTe and CIGS photovoltaics, GaN nanostructures, transparent conducting oxides, and ion conducting oxides. Brian's goal with APT is to directly determine the electrical, optical, and mechanical properties of these materials from the 3-D atomic scale chemistry. His group is also developing in-situ annealing techniques for atomic scale diffusion measurements using laser pulsed APT.

Brian has been an active contributor to the M&M annual meeting by chairing many technical sessions on FIB and APT. Currently, Brian serves as a Director of MAS. He has co-authored over 60 journal publications and has given over 70 invited presentations at national and international conferences.

## MAS 2014 Awards

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**Presidential Science Award**  
Hamish L. Fraser

**Hamish L. Fraser** graduated from the University of Birmingham (UK) with the degrees of B.Sc. (1970) and Ph.D. (1972). He was appointed to the faculty of the University of Illinois in 1973 (Assistant, Associate and Full Professor), before moving in 1989 to the Ohio State University (OSU) as Ohio Regents Eminent Scholar and Professor. He was appointed as a Senior Research Scientist at the United Technologies Research Center from 1979-1980. He has also been a Senior von Humboldt Researcher at the University of Göttingen, a Senior Visitor at the University of Cambridge, a visiting professor at the University of Liverpool, and spent a sabbatical leave at the Max-Planck Institut für Werkstoffwissenschaften in Stuttgart. He has been an Honorary Professor of Materials and Technology at the University of Birmingham since 1988. In 2014, he was recognized as an Honorary Professor at the Nelson Mandela Metropolitan University in Port Elizabeth, South Africa.

At present, he serves as Director of the Center for the Accelerated Maturation of Materials (CAMM) at OSU. He has been a member of the National Materials Advisory Board and the US Air Force Scientific Advisory Board. He has consulted for a number of national laboratories and several industrial companies. He is a Fellow of TMS, ASM, IOM3 (UK), and MSA. He has published over 380 papers in scholarly journals, and given over 280 invited presentations. He has graduated 48 doctoral students and 36 students graduating with the degree of M.S.

His work is based on research involving the development of advanced methods of materials characterization (involving high resolution and analytical electron microscopy), materials processing, and microstructure/property relationships. Dr. Fraser has an active research program in the development of new and improved materials, including: advanced materials characterization, direct 3-D microstructural representation, modeling microstructure/properties in light alloys, with an emphasis at present on Ti alloys, development of creep resistant beta-Ti alloys, development of low modulus beta-Ti alloys for orthopedic implants, and powder metallurgy, including additive manufacturing (LENS<sup>TM</sup>, hot isostatic pressing (HIP), and Kinetic Metallization). More recently, he has concentrated effort on establishing and developing the CAMM.



**Presidential Service Award**  
Ian M. Anderson

**Ian M. Anderson** has been a member of the Microanalysis Society since 1991. He became involved in MAS through the Society's technical programming, having organized numerous symposia beginning in 1996, the first Microscopy & Microanalysis (M&M) meeting. He served as Program Chair for M&M 2004. Ian has also been strongly involved in the Society's governance. He has served as Director (1999-2001) and President (2007-2008) of the Society. More recently he has served as Chair of the Strategic Planning Committee (2010-2014).

Ian's activities in MAS have focused on shoring up the foundations of the Society and in the involvement of a larger cross-section of the Society's membership in its activities. He oversaw the transition to standing committees of roles that had been filled for many years by dedicated individuals, in particular the establishment of Finance and Awards Committees. Ian is honored to receive the Society's Presidential Service Award.



# International Metallographic Society

doi:10.1017/S1431927614001202

## IMS Board of Directors 2014

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## Past Presidents

1968–1971	John H. Bender Jr.	1981–1983	George Vander Voort	1991–1993	Ian LeMay	2003–2005	Allan J. Lockley
1971–1973	Arthur E. Calabra	1983–1985	James E. Bennett	1993–1995	Japnell D. Brown	2005–2007	Dennis W. Hetzner
1973–1975	E. Daniel Albrecht	1985–1987	William E. White	1995–1997	E. Daniel Albrecht	2007–2009	David J. Fitzgerald
1975–1977	James H. Richardson	1987–1989	M.R. Louthan, Jr.	1997–1999	Mahmoud T. Shehata	2009–2011	Frauke Hogue
1977–1979	Robert J. Gray	1989–1991	Donald W. Stevens	1999–2001	Elliot A. Clark	2011–2013	Natalio T. Saenz
1979–1981	P.M. French			2001–2003	Richard K. Ryan		

## 2014 IMS Awards

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**President's Award**  
Frauke Hogue

**Frauke Hogue, FASM**, received her education in metallography and testing of materials in Berlin, Germany.

In 1967 she moved to the Los Angeles area and worked for Voi-Shan, a manufacturer of aerospace fasteners, in the Quality Control laboratory for 10 years. 1981 Frauke became an independent consultant in metallography, working mainly in the greater Los Angeles area, providing metallographic services to failure analysis companies.

Since 1985 she has been teaching intensive courses at ASM International and at companies throughout the United States and abroad. Frauke developed "Practical Interpretation of Microstructures" in 1998 which consists of a collection of about 300 mounts and a notebook of annotated images of various materials and conditions. This was followed by "Metallography for Fasteners" and "Metallography for Failure Analysis".

Other projects that ASM Frauke is involved in are: Mentor for Materials Camp since the inception in 2000 and the Micrograph Data Base. She has been involved with IMS for over 20 years, attending conferences, presenting papers and being part of the Board of directors.

Her interests are classical music, exploring the desert around Joshua Tree National Park, color metallography and meteorites.



**Jacquet-Lucas Award**  
Nabeel Hussain Alharthi

**Nabeel Hussain Alharthi** graduated from the mechanical engineering department of King Abdulaziz University (KAU), Jeddah, Saudi Arabia, 2001, after which he joined Saline Water Conversion Corporation in Jubail, Saudi Arabia as a mechanical engineer for one year. In 2003, he moved back to Jeddah to work for Saudi Arabian Airlines for four years as a material specialist. In 2007, he began working at King Saud University at Riyadh and received a scholarship to pursue the Master of Science and Doctor of Philosophy.

In 2008, he joined Lehigh University, Bethlehem, PA. In 2011, he received his M.Sc. in Mechanical Engineering and Mechanics from Lehigh University. He is currently a Ph.D. candidate in Mechanical Engineering and Mechanics department at Lehigh University working with Prof. Wojciech Misiolek in Institute for Metal forming.

## 2014 IMS Awards

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**2014 Henry Clifton  
Sorby Award**  
Stanley P. Lynch

### **Henry Clifton Sorby Award** Stanley P. Lynch

Stan Lynch (FASM) grew up in Liverpool, England before obtaining his B.Sc, M.Sc, and PhD degrees from the University of Manchester, Institute of Science and Technology, Dept. of Metallurgy. He has worked at the Defence Science and Technology Organisation (DSTO), Melbourne, Australia since then – with time off for good behaviour back in the UK on sabbaticals at the Royal Aerospace Establishment in Farnborough (1988-1989) and Alcan/Open University (1984). He also has an adjunct position at Monash University, Melbourne, where he has co-supervised a number of PhD students. Stan has focused on understanding the mechanisms of fatigue and fracture using a variety of metallographic and fractographic techniques, and has used this knowledge to determine the modes and causes of failure of structures and components in aeronautical, maritime, and other industries. Understanding the effects of environment on fatigue and fracture has been a particular focus, and he has published widely on stress-corrosion cracking, hydrogen-embrittlement, and liquid-metal embrittlement (often using mercury – which could account for some character traits!). He has proposed that many (but certainly not all) forms of environmentally assisted cracking can be explained by an Adsorption-Induced Dislocation Emission (AIDE)/Void-Coalescence mechanism, which still seems to be controversial. Stan has been an associate editor of several journals (e.g. Acta and Scripta Materialia, Journal of Failure Analysis and Prevention), and has presented lectures and courses in numerous countries around the world. His ‘outside’ interests include football (soccer), tennis, skiing, hiking, and more recently, cycling around Asia (Nepal, Thailand, Cambodia, Burma, Bali).

# 2014 IMS Society Awards

## President's Award (Service to IMS)

1977 Carus K. H. DuBose  
1978 Richard D. Buchheit  
1979 Arthur E. Calabra  
1980 James L. McCall  
1981 E. Daniel Albrecht  
1982 James H. Richardson  
1983 Robert J. Gray  
1984 Japnell D. Braun  
1986 P. Michael French  
1987 George F. Vander Voort  
1988 Robert S. Crouse  
1989 Ian Le May  
1990 William E. White  
1991 Chris Bagnall  
1992 Gary W. Johnson  
1993 Donald W. Stevens  
1994 MacIntyre R. Louthan, Jr.  
1995 Gunter Petzow  
1996 James Nelson  
1997 John Wylie  
1998 John W. Simmons  
1999 William Forgeng, Jr.  
2000 Nat Saenz  
2001 William W. Scott, Jr.  
2002 George Blann  
2003 Jeff Stewart  
2004 Elliot A. Clark  
2005 Chris Bagnall  
2006 Art Geary  
2007 Richard K. Ryan  
2008 Thomas S. Passek  
2009 David & Dale Fitzgerald  
2010 Jaret Frafjord  
2011 Donald F. Susan  
2012 Sarina Pastoric  
2013 Frauke Hogue

## Henry Clifton Sorby Awards

1976 Georg L. Kehl  
1977 Cyril Stanley Smith  
1978 Adolph Buehler  
1979 Frederick N. Rhines  
1980 Len E. Samuels  
1981 Robert J. Gray  
1982 Gunter Petzow  
1983 William D. Forgeng  
1984 Ervin E. Underwood  
1985 Alan Price  
1986 Robert W. K. Honeycombe  
1987 Gareth Thomas  
1988 Franz Jeglitsch  
1989 Tanjore R. Anantharaman  
1990 E. Daniel Albrecht  
1991 W. C. Leslie  
1992 Charles S. Barrett  
1993 Raimond B. Castaing  
1994 F. Brian Pickering  
1995 Erhard Hornbogen  
1996 Peter Duncumb  
1997 Robert T. DeHoff  
1998 Kay Geels  
1999 Joseph Goldstein  
2000 Hans Eckhart Exner  
2001 Brian Ralph  
2002 Walter Mannheimer  
2003 Enrica Stagno  
2004 George F. Vander Voort  
2005 Iain LeMay  
2006 Arlan Bencotter  
2007 McIntyre R. Louthan, Jr.  
2008 Lawrence E. Murr  
2009 Chris Bagnall  
2010 Albert C. Kneissl  
2011 David Williams  
2012 Michael Pohl  
2013 Arun M. Gokhale  
2014 Stanley P. Lynch

## Jacquet-Lucas Award For Excellence in Metallography

1946 G.R. Kuhn  
1947 R.H. Hays  
1948 E.C. Pearson  
1949 D.H. Rowland  
1950 S.O. Modin  
1951 H.P. Roth  
1952 H. Griffin  
1953 B.C. Leslie, R.J. Gray  
1954 R.D. Buchheit, J.E. Boyd,  
A.A. Watts, F.C. Holden  
1955 F.M. Cain, Jr.  
1956 D. Mannas  
1957 T.K. Bierlein, B. Mastel  
1958 J.C. Gower, E.P. Griggs, W.E. Denny,  
J.E. Epperson, R.J. Gray  
1959 F.M. Beck  
1960 G.C. Woodside  
1961 J.F. Radavich, W. Coutts, Jr.  
1962 D. Medlin  
1963 W.C. Coons  
1964 B.C. Leslie, R.J. Gray  
1965 W.C. Coons, A. Davinroy  
1966 D.M. Maher, A. Eikum  
1967 J.F. Kisiel  
1968 R.M.N. Pelloux, Mrs. H. Wallner  
1969 R.H. Beauchamp, R.P. Nelson  
1970 D.R. Betner, W.D. Hepfer  
1971 R.J. Gray  
1972 C.J. Echer, S.L. Digiallonardo  
1973 M.S. Grewal, B.H. Alexander, S.A. Sastri  
1974 M.P. Pinnel, D.E. Heath, J.E. Bennett,  
G.V. McIlharagie  
1975 W.C. Coons  
1976 L.E. Soderqvist  
1977 R.H. Beauchamp, D.H. Parks, N.T. Saenz,  
K.R. Wheeler  
1978 C. Bagnall, R. Witkowski  
1979 M.J. Bridges, S.J. Dekanich  
1980 R.H. Beauchamp, K. Fredriksson  
1981 F. Kurosawa, I. Taguchi, H. G. Suzuki  
1982 M.J. Carr, M.C. Mataya, T.O. Wilford,  
J.L. Young  
1983 V. Carle, E. Schmid  
1984 R.H. Beauchamp, N.T. Saenz, J.T. Prater  
1985 U. Taffner, R. Telle  
1986 N.T. Saenz, C.A. Lavender, M.T. Smith,  
D.H. Parks, G.M. Salazar  
1987 S.A. David, J.M. Vitek, C.P. Haltom,  
A.G. Barcomb  
1988 A. David, J.M. Vitek, A. Boatner,  
G.C. Marsh, A.B. Baldwin  
1989 G. Hoerz, M.C. Kalfass

## 2014 IMS Society Awards

### Jacquet-Lucas Award For Excellence in Metallography - (continued)

1990 A. David, J.M. Vitek, A.B. Baldwin	1998 R. Pereyra, E.G. Zukas	2008 T. Nizolek
1991 M.R. Jones	1999 K.R. Luer	2009 B. Gerard
1992 G.F. VanderVoort	2000 D.J. Lewis, S. Allen	2010 Hendrik O. Colijn and Christopher G. Roberts
1993 T. Leonhardt, F. Terepka, M. Singh, G. Soltis	2001 D. Chakrapani	2011 Christopher Marvel
1994 J.W. Simmons, B.S. Covino, Jr., S.D. Cramer, J.S. Dunning	2002 F.F. Noecker, II	2012 Zhiping Luo
1995 Kamal, K. Soni, R. Levi-Setti, S. Shah, S.J. Gentz	2003 F.F. Noecker, II	2013 Nabeel Hussain Alharthi
1996 R.L. Bodnar, S.J. Lawrence	2004 R. Unocic, P.M. Sarosi, M.J. Mills	
1997 J. Yewko, D.L. Marshall	2005 K. Kimura, S. Hata, S. Matsumura, T. Horiuchi	
	2006 R. Deacon	
	2007 K.A. Unocic, G.S. Daehn	

## History of the IMS Awards

**HENRY CLIFTON SORBY AWARD**—The Sorby Award was established to recognize outstanding contributions to the field of metallography by an internationally recognized senior figure in the field of metallography. This award is a personalized plaque, and the recipient is honored during the M&M Conference Sorby lecture and at the IMS Annual Meeting banquet.

**PIERRE JACQUET-FRANCIS F. LUCAS AWARD**—The Jacquet-Lucas Award is given each year to the International Metallographic Contest entry judged “Best in Show” by a panel of judges. This is a joint IMS/ASM award with origins dating back to 1946, and has been endowed by Buehler Ltd. since 1976. The winners receive the Jacquet Gold Medal, the ASM Lucas Award, a cash award, and are honored at banquets at both the IMS Annual Meeting and the ASM Annual Event.

### The 2013 International Metallographic Contest Judging Team

Chair: Alice Kilgo, Sandia National Laboratories  
Local Chair: Brian Rose, Columbus Technical Center  
Steven Gentz, NASA Marshall Space Flight Center  
Tom Murphy, Hoeganaes  
Chris Bagnall, Product Evaluation Systems Inc.  
David Chang, Rolls-Royce Corporation  
Amber Trees, SEMTEC Laboratories Inc.  
Lee Garrett, Buehler

**PRESIDENT’S AWARD**—This award is presented to an individual deemed deserving of special recognition by the Society. This award is a plaque personalized for the recipient.

**BUEHLER TECHNICAL PAPER MERIT AWARD**—This award shall be given annually to the authors of the technical paper published that year in the journal *Materials Characterization* that was determined most outstanding by a panel of IMS judges. A plaque and cash award is given to the recipients each year by Buehler Ltd.

**PAST-PRESIDENTS AWARD**—This award shall be presented by the Board of Directors to the out-going Past-President in recognition of their contributions to the Society. This award is a plaque personalized for the recipient.

**PRESENTATION OF THE IMS AWARDS**—The awards are presented at the annual banquet on Wednesday, August 6, 2014, at 6:30 PM.

### We would like to thank the IMS Members who helped organize the M&M 2014 Conference

James Martinez, *M&M 2014-2015 IMS Co-Chair*  
Frauke Hogue, *Symposia Co-Chair*  
Frank Mücklich, *Symposia Co-Chair*  
Rhonda M. Stroud, *Symposia Co-Chair*  
Zack Gainsforth, *Symposia Co-Chair*  
Daniel P. Dennies, *Symposia Co-Chair*  
Ronald J. Parrington, *Symposia Co-Chair*  
S.K. Sundaram, *Symposia Co-Chair*  
Edward P. Vicenzi, *Symposia Co-Chair*  
Marc Walton, *Symposia Co-Chair*  
Loïc Bertrand, *Symposia Co-Chair*  
Alice Kilgo, *International Metallographic Contest Chair*  
Jeff Stewart, *International Metallographic Contest Local Chair*

# Microscopical Society of Canada / Société de Microscopie du Canada 2014

doi:10.1017/S1431927614001512

## MSC-SMC Council Officers—Membres du Conseil

### Executive Council / Conseil Exécutif

President	Anja Geitmann
1st Vice President	Michael Robertson
2nd Vice President	TBA
Secretary	David O'Neil
Treasurer	Pierre Mathieu Charest
Past President	Randy Mikula

### Councillors-at-Large

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Martin Couillard  
Jeff Fraser  
Douglas Hall  
Zygmunt Jakubek  
Pen Li  
Florence Perrin-Sarazin  
Isabelle Rouiller  
Stephen Wood

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Pen Li	
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Isabelle Rouiller	
Stephen Wood	

### Section Chairs

Alberta	Marek Malac
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Ontario	Jeff Fraser
Pacific	Garnet Mongeon
Quebec	Line Mongeon

## MSC-SMC Sustaining Members / Membres

Buehler Canada  
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Electron Microscopy Sciences  
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Carl Zeiss SMT



# Microscopical Society of Canada / Société de Microscopie du Canada 2014

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## MSC-SMC Past Presidents / Anciens Presidents

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1975-1977	E.J. Chatfield	1993-1995	L. Arsenault
1977-1979	G.T. Simon	1995-1997	R. Sherbourne
1979-1981	G.H. Haggis	1997-1999	J. Corbett
1981-1983	F.P. Ottensmeyer	1999-2001	G. Harauz
1983-1984	D.A. Northwood	2001-2003	R. Gauvin
1984-1985	J.M. Sturgess	2003-2005	E. Humphrey
1985-1987	D.A. Graig	2005-2007	G. Botton
1987-1989	R.F. Egerton	2007-2009	C. Bennett
1989-1991	P.J. Lea	2009-2011	D. Beniac
1991-1993	G. L'Esperance	2011-2013	R. Mikula

## SC-SMC 2013 Gérard T. Simon Award

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**Haitian Xu**, University of Victoria “Ultrafast Magnetic Imaging in Small Magnetic Elements”.

**Shelly Au**, University of British Columbia “Baculovirus Nuclear Import: Open NPC Sesame”.

## The Canadian Foundation for the Development of Microscopy Travel Awards

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The Canadian Foundation for the Development of Microscopy (CFDM), an arm of the Microscopical Society of Canada, is a charitable organization whose aim is to promote the development of microscopy and associated techniques. Part of its mandate is to provide funds for educational opportunities for young scientists. In 2010 we are offering two awards to assist with the travel expenses of Canadian university students to participate in the Microscopy & Microanalysis Conference. The Board of the CFDM will review submissions by students and evaluate them according to the following criteria: scientific merit, significance of their research, creativity, and a letter of reference. The deadline for submissions is May 1st and recipients are announced on the MSC website: <http://www.msc-smc.org/>.

# Microscopical Society of Canada / Société de Microscopie du Canada 2014

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## 2014 CFDM Travel Award Winners (in conjunction with IUMAS)

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**Samuel Bastien**, Université de Sherbrooke.  
**Xiaohui Zhu**, McMaster University.

### The Francis Doane Award

#### In recognition for their outstanding service to the Microscopical Society of Canada

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**Odette Desbiens** started her career in electron microscopy in 1968 at the Research Center of the Laval Hospital in Quebec City, working with pathologist Dr. Paul-Émile Roy. An internship in the laboratory of Dr. Rosita F. de Estable-Puig at the Faculty of Medicine of Laval University instilled in her the love for microscopy. In 1969, Odette joined the group of Dr. Georges Olah at the Faculty of Agricultural and Food Science at Laval University and had the opportunity to receive advanced training in microscopy in France, England, Germany, and in the US. In 1997 Odette moved to the new Life Sciences building of Laval University where she worked at the electron microscopy platform until her retirement in 2000.

Remarkably, Odette has been member of the Microscopical Society of Canada (MSC) ever since the very first annual meeting of the Society in 1974. She has assisted approximately 25 annual meetings of the Society and was involved in the organization of three of these. She completed three mandates as Councilor-at-large and then became council member ex officio as the first webmaster having set up the first web site of the MSC in 1999. She remained the webmaster and was active in the Society until 2010. Odette's service to the Society has been extraordinary. Her continuous dedication to the functioning of the MSC has been exemplary. By giving the Society an online presence, Odette single-handedly ensured the MSC's smooth transition to the 21st century. It is a great pleasure for the Society to recognize Odette's contribution by awarding her the Frances Doane Award.

### Past Francis Doane Award Winners

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2002	Jim Corbett	2009	Rakesh Bhatnagar
2006	Ray Egerton	2010	Nancy Clark
2008	Pierre-Mathieu Charest	2012	Fran Leggett



# International Union of Microbeam Analysis Societies (IUMAS) 2014

doi:10.1017/S1431927614001524

## Established 1994

The International Union of Microbeam Analysis Societies, founded in 1994, is a non-profit organization of professional societies whose objective is to promote world-wide cooperation in all aspects of microbeam analysis, to achieve this through the organization of an International Congress on microbeam analysis every four years, and to participate in joint committees with other scientific organizations in matters relevant to microbeam analysis which are better discussed on a world scale.

## IUMAS Council

IUMAS President	Se Ahn Song
IUMAS Secretary	Nicholas W.M. Ritchie
IUMAS Past President	Brendan Griffin
Australian Microbeam Analysis Society	Richard Wuhrer, President
CSIRO Australia	Colin MacRae
Canadian Microscopical Society	Anja Geitmann, President
Canadian Federation for Development of Microscopy	Pierre-Mathieu Charest
Brazilian Society for Microscopy and Microanalysis	Sonia Bao
Microanalysis Society	Edward Vicenzi
The 141 <sup>st</sup> Committee on Microbeam Analysis, Japan	Yahichi Sato, President
Technical Committee of Microbeam Analysis, China	Jiang Zhao
Technical Committee of Microbeam Analysis, China	Fen Liu
Korean Society of Microscopy	Young-woon Kim
European Microbeam Analysis Society	Michael B. Matthews, President
European Microbeam Analysis Society	Xavier Liovet, Vice President

## Past Meetings

	<b>Location</b>	<b>Chair</b>
2012	Seoul, South Korea	Se Ahn Song
2008	Perth, Australia	Brendan Griffith
2005	Firenze, Italy	Clive Walker
2000	Kona, Hawaii USA	David Williams
1996	Sydney, Australia	Clive Nockolds

## At-Large ECS Winners Supported by Microbeam Analysis Society

Aki Takigawa, *Carnegie Institute of Washington*

“Morphologies, Isotopes, Crystal Structures, and Microstructures of Presolar Al<sub>2</sub>O<sub>3</sub> Grains: a NanoSIMS, EBSD, EDS, CL, and FIB-TEM Study”

Shirin Kaboli, *McGill University*

“Electron Channeling Contrast Observations in Deformed Magnesium Alloys”

## Australian Microbeam Analysis Society

Aoife McFadden, *University of Adelaide South Australian Museum*

“Otolith Biomineralisation: Insights From a Microstructural and Microanalytical Study”

Tim Murphy, *University of Western Sydney*

“Mineral Analyses & Implications on the Dispersion of Bismuth in the Super-gene Environment of Eastern Australia”

“X-ray Mapping Investigations of the Monazites from the Mt Weld Deposit - Compositional Variance as an Indicator of Provenance”

## Brazilian Society for Microscopy and Microanalysis

Vitor Hugo Balasco Serrao, *Electron Microscopy Physics Institute of São Carlos, University of São Paulo*

“Investigation of *Escherichia coli* Selenocysteine Synthase (SelA) Complex Formation Using Cryo-Electron Microscopy (Cryo-EM)”

Patricia Fernanda Andrade, *Department of Chemistry, University of Campinas*

“Structural and Morphological Investigations of β-Cyclodextrin-Coated Silver Nanoparticles”

## Canadian Society for Microscopy, Canadian Federation for Development of Microscopy

Samuel Bastien, *Chemical and Biotechnological Engineering, Université de Sherbrooke*

“Plasma Synthesis of Faceted Nickel nano-Ferrites with Controlled Stoichiometry”

Xiaohui Zhu, *Chemistry and Chemical Biology, McMaster University*

“Probing Magnetic Polarities of Magnetotactic Bacteria by X-ray Magnetic Circular Dichroism in a Scanning Transmission X-ray Microscope”

## Technical Committee of Microbeam Analysis of China

Zhu Ruan, *University of Science and Technology of China*

“Quantum Monte Carlo Simulation for Atomic Resolution SEM/STEM Image”

Yanbo Zou, *University of Science and Technology of China*

“Model-Based Library for Critical Dimension Metrology by CD-SEM”

## European Microbeam Analysis Society

Aurélien Moy, *Commissariat à l'Énergie Atomique, Centre de Marcoule DEN/DTEC/SGCS/LMAC*

“Quantification Of Actinides By EPMA: A New Accurate Standardless Approach”

Philippe T. Pinard, *RWTH Aachen Gemeinschaftslabor für Elektronenmikroskopie (GFE)*

“Towards Reliable Quantification of Steel Alloys at Low Voltage”

## Japan – The 141<sup>st</sup> Committee on Microbeam Analysis

Masaru Irita, *Tokyo University of Science*

“A Study of Single-Walled Carbon Nanotube Cap Structure Using Field Emission Image”

Shoko Matsushita, *School of Medicine, Hamamatsu University*

“Volatile p-nitroaniline as Matrix for High Spatial Resolution Imaging of Phospholipids in Both Ion Modes by AP-MALDI-IMS”

## KSM, Korean Society of Microscopy

Yinsheng He, *School of Nano & Advanced Materials Engineering*

“Microstructural Evolution of SS304 upon Various Shot Peening Treatments”

Youngji Cho, *Korea Maritime and Ocean University*

“Morphology and Structure Analysis of Graphene by Low Voltage TEM”

The Microanalysis Society is pleased to hold the **Sixth Meeting of the International Union of Microbeam Analysis Societies (IUMAS)** in conjunction with **Microscopy & Microanalysis 2014**. All M&M 2014 attendees are encouraged to arrive a couple of days early to participate in the exciting scientific program and social activities of IUMAS-6!

## IUMAS HALF-DAY WORKSHOPS

**SATURDAY, AUGUST 2, 2014**

**Connecticut Convention Center, Rooms 12-17**

These workshops are designed to be highly interactive, with substantial exchange among the participants under the moderation of the conveners. IUMAS delegates will attend two half-day workshops, one in the morning and the other in the afternoon.

**8:30 AM – 12 PM**

### Advanced Electron Probe Microanalysis

Paul K. Carpenter, Washington University in St. Louis, USA  
Silvia Richter, Aachen University, Germany

### Atom Probe Tomography

Thomas F. Kelly, Cameca Instruments, USA  
François Vurpillot, Université de Rouen, France

### Electron Backscatter Diffraction

Joseph R. Michael, Sandia National Laboratories, USA

### Electron and X-ray Spectroscopies in the TEM/STEM

Nestor J. Zaluzec, Argonne National Laboratory, USA

### He/Ne Ion Microscopy and Microanalysis

David C. Joy, University of Tennessee and Oak Ridge National Laboratory, USA

### Quantitative X-ray Microanalysis by XEDS

Dale E. Newbury, National Institute of Standards and Technology, USA

**1:30 PM – 5 PM**

### Trace Element Microanalysis by Laser Ablation ICP-MS

Alan Koenig, U.S. Geological Survey, USA

### Focused Ion Beam Microscopy and Microanalysis

Lucille A. Giannuzzi, L.A. Giannuzzi and Associates, USA  
Keana Scott, National Institute of Standards and Technology, USA

### Microanalysis in the Variable Pressure SEM

Brendan J. Griffin, The University of Western Australia

### Quantitative X-ray Microanalysis by XEDS

Dale E. Newbury, National Institute of Standards and Technology, USA

### Scanning Probe Microscopy

Phillip E. Russell, Appalachian State University, USA

### Spectral Imaging and Analysis

Nicholas C. Wilson, CSIRO-Minerals, Australia  
Paul G. Kotula, Sandia National Laboratories, USA

### X-ray Spectral Processing and Simulation

Nicholas W. M. Ritchie, National Institute of Standards and Technology, USA  
Xavier Llovet, Universitat de Barcelona, Spain

## SUNDAY KEYNOTE PRESENTATION

**8:45 AM**

**Connecticut Convention Center, Room 15-16-17**

### *My Lab is on Mars: Geochemical Adventures with the Mars Curiosity Rover*

**Professor Laurie A. Leshin**  
**Office of the President,**  
**Worcester Polytechnic Institute, USA**



Professor Laurie Leshin is a leader in the field of cosmochemistry, with primary research interests in deciphering the record of water in objects within our solar system. Prior to her appointment as President of WPI, Prof. Leshin served as the Dean of the School of Science at Rensselaer Polytechnic Institute and the Deputy Director for Science and Technology at the NASA Goddard Space Flight Center. She is an active member of NASA's current mission, the Mars Science Laboratory. In her talk, she will share her unique perspective regarding the findings of the Mars Curiosity Rover.

## IUMAS PLENARY SESSION

**SUNDAY, AUGUST 3, 2014**

**Connecticut Convention Center – Room 15-16-17**

- 10:30 AM** **Multi-spectral Electron Microprobe- Now and Future**  
Colin M. MacRae, CSIRO-Minerals, Australia
- 11:10 AM** **Advances in Acquisition of Hyperspectral Images**  
Paul G. Kotula, Sandia National Laboratories, USA
- 11:50 AM** **Atomic Resolution X-ray Analysis in Aberration-Corrected Scanning Transmission Electron Microscopes: Current Limits and Challenges toward Quantification**  
Masashi Watanabe, Lehigh University, USA
- 1:30 PM** **H.G.J. Moseley; The Scientist Who Put the Z in ZAF (and kab)**  
David Williams, The Ohio State University, USA
- 1:50 PM** **Impacts of Atom Probe Tomography on the Electronic and Photonic Device Technology**  
Chan-Gyung Park, Pohang University of Science and Technology, Korea
- 2:30 PM** **Robert E Ogilvie: Inventor, MAS Founder, and Educator**  
Joseph Goldstein, University of Massachusetts, USA
- 2:50 PM** **Advances in Electron Energy-Loss Spectroscopy with High Spatial and Energy Resolution**  
Gianluigi Botton, McMaster University, Canada
- 4:00 PM** **Mass Spectrometry of Surfaces Using Ion Beam: Molecular Mapping of (Bio)Polymers**  
Birgit Hagenhoff, tascon GmbH, Germany
- 4:40 PM** **Elemental Analysis of Cells & Tissues**  
Peta L. Clode, The University of Western Australia